Consortium on Systems Approaches to Safety and Security
(C-SASS)

For more information about C-SASS or to express interest in participating, contact Nancy Leveson (leveson@mit.edu)

1. Goals

The increasingly complex systems we are building today enable us to accomplish tasks that were previously difficult or impossible. At the same time, they have changed the nature of accidents and security incidents and increased the potential to harm not only life today but also future generations.

Traditional system safety approaches, which started in the missile defense systems of the 1950s, are being challenged by the introduction of new technology and the increasing complexity of the systems we are attempting to build. Software is changing the causes of accidents and the humans operating these systems have a much more difficult job than simply following predefined procedures. We can no longer effectively separate engineering design from human factors and from the social and organizational system in which technological systems are designed and operated.

The analogous problems are occurring with approaches to security, which have been based on the same linear, reductionist thinking as have approaches to safety.

A potential solution is to take a systems approach to safety and security and apply systems thinking as outlined in Leveson's 2012 book *Engineering a Safer World*. The goal of the Consortium on Systems Approaches to Safety and Security is to create new tools and processes that implement this systems thinking approach.

Engineering safer systems will require multi-disciplinary and collaborative research based on sound system engineering principles. The consortium is cross-industry and cross-disciplinary. Recent or current research projects by students and faculty involved in the consortium have examined aviation (aircraft and air transportation systems), spacecraft, medical devices and healthcare, automobiles, railroads, nuclear power, defense systems, energy, and large manufacturing/process facilities (such as oil and gas). Cross-disciplinary topics include:

- New, more powerful hazard and vulnerability analysis techniques
- Accident investigation and causality analysis
- Security
- Safety and security guided system design (Design for Safety and Security)
- Human factors and safety/security
- Integrating safety and security into the system engineering process
- Identifying leading indicators of increasing risk
- Certification, regulation, and standards
- The role of culture, social, and legal systems on safety and security
- Management and operation of safety-critical and security-critical systems

2. Principles for the Operation of C-SASS

C-SASS will operate with several basic guiding principles:
- Collaboration: Emphasis will be on collaborative research with like-minded thinkers around the world who want to apply systems thinking to safety and security. Collaborators will include universities, government agencies, companies, and other groups worldwide.
- Systems thinking: Research will look at safety and security from a holistic, systems approach rather than just at the technical, managerial, or social factors in isolation from each other. Our solutions will be based on systems theory.
- Solve real problems: The goal is to have impact on risk management as practiced and on accidents and security incidents as experienced in the world, not simply to publish academic papers.
- Guided by the needs of stakeholders: Problems on which to focus will be selected for their importance in real-world settings. Partners in industry and government and other stakeholders (users of these systems and employees who work in them) will provide inputs about unsolved problems they face.
- Enhance communication and cooperation: The consortium will operate as an "honest broker" and provide an environment where companies, regulatory agencies, and other stakeholders (e.g., users, employees and unions, customers) can cooperate without conflict of interest or legal issues.

- Technology transfer: Technology transfer from research to practice will be emphasized including implementing and tailoring specific solutions for a particular company or government agency.
- Consider all aspects of system safety: The entire system lifecycle will be considered. Too often researchers focus on system design and development and apply less effort to operations and management.
- Socio-technical view of safety and security: The entire socio-technical structure will be considered from government to management and down to designers and operators. Effective solutions to safety and security problems usually require changes at all these levels, not just in the physical system itself.
- International viewpoint: Solutions should be applicable globally and not just to particular countries or parts of the world or specific industries.

3. Potential C-SASS Activities

- Evaluation of current practices in industry and in government certification and regulation of safety-critical systems and the efficacy of both old and new approaches.

- Focused research on problems suggested by and supported by our industrial and governmental partners.

- Mentoring and internships by graduate students in industry and government, including research grounded in specific company and governmental problems.

- Newsletters and other information dissemination channels about activities, results, etc., including early access to thesis abstracts and results.

- Sponsored research

- Educational activities including short classes and workshops for C-SASS partners.

- Knowledge and information sharing

- Annual conference

- Visitors from industry, government, and other research institutions

4. Education

Universities exist not just to do research but also to educate the leaders, teachers, and researchers of the future. Students will be able to participate in the consortium research while getting graduate degrees in various MIT departments or at other universities.

In addition to the usual graduate research programs, MIT has several professional degree programs where students who have industrial experience return for a master's degree. These programs include System Design and Management, Technology and Policy Program, and Leaders for Global Operations (where the students get both an Engineering master's degree and an MBA from the MIT Sloan School of Management). Some students currently in these programs participate in C-SASS research and we hope to increase this participation.

Students who graduate with a bachelor's degree and go to work in industry often have no introduction to system safety and must learn it on the job. We introduced a new undergraduate class at MIT in the fall of 2012 that teaches basic skills for analyzing, designing, operating, and managing safety-critical systems. Introduction of modules about safety and security within the required classes is also being considered.

The consortium will also provide classes for industry and continuing education in system safety and security.

5. Governance and Structure

Director: Prof. Nancy Leveson, Aeronautics and Astronautics and Engineering Systems Division

Executive Director: Dr. John Thomas

Currently Affiliated MIT Faculty:
　Prof. John Carroll, Sloan School and Engineering Systems Division
　Dr. Stan Finkelstein, MIT Engineering Systems Division, Harvard Medical School
　Prof. Joseph Sussman, Civil Engineering and Engineering Systems Division
　Dr. Qi van Eikema Hommes, Engineering Systems Division

Safety and Security Exchange Partners: Those interested only in participating in information sharing activities. Costs to be determined ($10,000 per year).

Industrial and Government Research Partners: Research partners will sponsor research, participate in graduate student internships and focused research, and participate in the information sharing activities. Costs ($25,000 per year).

Industrial/Government Advisory Board (Strategic Partners): A higher level of participation and commitment, including providing guidance in strategic decision making and participation in all the consortium activities. ($200,000 per year).

Regular Sponsored Research Projects will still exist apart from these memberships.

6. Member Benefits

Benefits	Networking Partners	Research Partners	Strategic Partners
Recognition in publications and website as a member of MIT's C-SASS	Yes	Yes	Yes
In-depth conversations with consortium faculty, researchers, and students	Yes	Yes	Yes
Network and exchange opportunities within MIT and with consortium's corporate and government partners	Yes	Yes	Yes
Consortium electronic newsletter	Yes	Yes	Yes
Regular briefing materials and webinars on research	Yes	Yes	Yes
Graduate student recruiting opportunities	Yes	Yes	Yes
Invitations to additional focused STAMP meetings beyond the spring workshop to hear and discuss research findings	Yes (up to 2 attendees free)	Yes	Yes
Opportunity to engage MIT C-SASS researchers for special presentations (for an additional fee)	Yes	Yes	Yes
Participation in the research process, including input into project selection and potential inclusion as a research or test site	No	Yes	Yes
Early access to research results	No	Yes	Yes
Networking with Research Partner peers in focused research areas	No	Yes	Yes
Research collaboration activities on company/organization-specific topics	No	Yes (limited)	Yes

Member of consortium Advisory Group to provide direction on consortium activities and research	No	No	Yes
Opportunity for in-house or MIT education on techniques and tools (5 days a year)	No	No	Yes
Free seats at special once-a-year short classes at MIT on STAMP-related topics	No	2 seats	5 seats

The consortium will not provide consulting services, but there will be opportunities to work with MIT researchers on company-specific research projects.

Research and Strategic Partners: To participate in company-related thesis research with student(s), companies will be expected to assign someone internal to interact with the student(s) and act as liaison with the company management, and to pay any travel expenses for MIT team members to the company locations.

Regular sponsored research projects with MIT consortium participants will still be possible but will be funded outside the Consortium framework.

A plan for Intellectual property (IP) management and rights for consortium members will be negotiated with the consortium members and MIT.

A plan for participation by academic members (at other universities) will be decided after the basic consortium is formed.