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Title:	A Survey of Risk-based Design Methodologies, Tools, Practices and Trends within NASA

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Abstract: (Your abstract must use Normal style and must fit in this space)

In the past fifteen years, NASA has launched a number of projects and initiatives to develop methodologies and tools to manage risk during the design lifecycle through accounting for risk in the design process itself. These methodologies are sometimes grouped together under the term *risk-based design*. Accounting for and managing risk in the design process is a specialized area of general risk management that looks at factors that affect the actual design outcome. In a risk-based design process, engineers should be able to apply their own domain expertise to reduce risk and account for uncertainties that arise from the design solutions that they develop.

Throughout the agency, different research groups, design centers and mission programs have each developed their own methodologies and tools to manage risk. In this paper, we provide a survey of risk-based design activities throughout the Agency and seek to situate them within the larger framework of the design lifecycle and project risk management. We will categorize these activities under more general titles such as:

- Failure mode identification and analysis during early design
- Quantitative methods for design risk assessment
- Formal methods for design decision making
- Co-design of health management and early warning systems
- Characterization of uncertainty in performance parameters
- Resource allocation to optimize risk investments

By understanding where in the design lifecycle each of these methodologies can be applied, we can identify gaps where new methodologies should be developed. Further, we can work towards developing design process guidelines and practices that will enable radical improvements in mission reliability and safety. We will argue that design risk analysis data may also feed into other project and program risk management activities, including project risk identification and assessment, risk tracking, resource allocation, problem reporting and anomaly resolution. Finding useful relationships between design risk data and project risk management is an open problem that requires an understanding of the risk management process and the tools that are employed.

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