Integrating Ergonomics Design and Build Criteria into Airplane Product Development

Peregrin Spielholz, Richard Gardner, Shruti Gangakhedkar, Kate Ackerman, Adam Richardson

The Boeing Company, Seattle, Washington, USA

1. Scope
Many companies have been moving assessment of factory injury risk and producibility impacts for new products upstream in the development cycle with integrated design teams (Sundin et al., 2004; Hagg, 2003). The goal is a worthy one, with the apparent potential for cost savings and accounting for the full impact of design decisions while flexibility exists to change form and specifications. However, the reality of integrating criteria and assessment processes can have limitations as well.

Development of clear, valid, and verifiable criteria is critical to success of integrating ergonomics into product development. The type and content of criteria may vary significantly by the type of product, company, assembly location, and program goals. Determining what criteria are program requirements and what are more appropriate as objectives is an important consideration. Assignment of requirements and objectives to product design criteria is different in content and type from build-system requirements and objectives.

The phase-gate project management process has been commonly used for product development and infrastructure projects (Kerzner, 2009). This paper presents the method and lessons learned from the experience of integrating and assessing ergonomics criteria from the beginning of gated-process product development for a derivative commercial airplane program.

2. Project Organization
Workplace ergonomics requirements development and assessment in aerospace manufacturing has previously been directed largely toward evaluation of the build system. Performing evaluation of workplace ergonomics impacts during airplane product design required implementing specific design requirements and new assessment tools and processes matched to the level of design maturity at different phases of development.

Factory ergonomics impact assessment of product design was implemented from the start of the phase-gate project management process for airplane development on the Boeing 737 MAX, 787-10 and 777X. Ergonomics risk assessment and mitigation was included as gated-process criteria throughout the development cycle. Airplane-level design requirements and objectives were developed and adopted by the program, followed by development of build requirements and objectives. Methods of criteria assessment and tracking were developed and used for evaluating both design and build requirements and objectives.

3. Project Phases
A process was developed for identifying product changes with potential impact to worker health and safety. Methods were created for evoking more detailed assessment and mitigation prior to preliminary design. Incorporation of this process on a derivative commercial airplane resulted in over 50 airplane design changes that improved ergonomics and producibility on the Boeing 737 MAX. Development of build system criteria and tools for integration and assessment on the Boeing 787 airplane was part of the lower injury rates during program ramp-up compared to previous programs. Immersive digital team reviews of targeted installations were particularly valuable in both developing solutions and finding unknown design issues early in development.

4. Conclusion
Adoption and evaluation of these requirements drove and documented airplane design-changes that reduced ergonomic risk factors. Incorporating ergonomics at the beginning of the product development process, and embedding subject-matter experts with the design teams had a positive impact in design improvements that increased producibility and reduced injury risk.

References