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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Product development of systems with robot, intelligent and autonomous characteristics is rapidly progressing. Given the human-system issues of such systems, timely guidance covering these issues is necessary to help all sectors of industry to design, field and operate first-time quality robotic, intelligent, autonomous (RIA) systems, and build appropriate trust in products and services that use these systems.

There is an urgent need for a Technical Report from ISO explaining the existing, emerging and potential human-system issues and consequences for use and users associated with systems that have robot, intelligent and autonomous characteristics. This document explains the existing, emerging and potential human-system issues and consequences for use and users associated with systems that have RIA characteristics. It identifies the potential risks and priorities for standardization to address these issues. Solutions will be the subject of future standards.

This document reviews the ergonomics for a range of RIA systems. It describes the human-system issues that should be considered in the application of these technologies and identification of priorities for future standardization work. The purpose of this study is to identify and explore the ramifications of a categories of issues involving RIA systems that suggest a need to reset the boundaries of what is called ergonomics. The conclusion is that to make an ergonomic RIA system, the practice of ergonomics will need to do more, working together with new disciplines, and can require new tools, methods and approaches to support the design and integration of these types of systems into working environments and organizations. Ergonomics will also need to identify relevant research from a wide variety of scientific disciplines, as well as conducting our own research to ensure we have a robust evidence base to guide the development of these systems.

The paradigm behind human-systems interaction standards so far has been that of tool use. The ISO 9241 series is for interactive tools and the physical environment within which they are used. RIA systems necessitate a new paradigm. Agents developed using these technologies will be more connected, complex, probabilistic and non-deterministic, social, and augment human capabilities well beyond merely replacing physical work. Interaction with these agents can become a relationship, their interface a personality, and users and agents can form complex human-machine teams, working together towards a shared goal.

The evolution of RIA systems will significantly alter the nature of tasks users perform. The design of work will likewise be altered. Applications of RIA systems represent a significantly more complete and impactful replacement of human activity than has been seen with any other form of technological labour-saving device. For example, when working with another person on a common task, how do you diagnose a failure state in your interactions? How are you to interpret the off-nominal behaviour of a team member? How are you to interpret and predict the behaviour of other people who are operating within the same environment as you are but are otherwise not directly coordinating activity? What is the safe state you can fall back on in the event of a failure in your interaction with another person? Now, replace that person or team member with an RIA system. The changes in the nature of tasks and the design of work to accommodate the complex, social human-machine interaction of an RIA system is fundamental for ergonomics, but will require that the ergonomics community adapt its best practices and expand into areas of psychology and sociology that few ergonomists deal with on a regular basis.

The focus of this document is breadth not depth, and issues not answers. The emphasis is on describing general issues and the consequences of not addressing them, even though not all will/can be relevant to all types or applications of RIA systems covered by this document. But be sure that this is the case for your application, and that you take account of the categories of issue and context that do apply.

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