

UTILIZATION OF THE SOFTWARE PRODUCT TECNOMATIX JACK IN OPTIMIZING OF WORKING ACTIVITIES

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Abstract: The article deals with the issue of ergonomics in the workplace in the environment of simulation program Tecnomatix Jack. Ergonomics deals with a complex design of work environment and environment, also deals with projection of work tools, machinery construction and with the principles of occupational health in order to reduce human effort while increasing worker productivity and efficiency of its work. The benefits related to the use of simulation programs are verifiable mainly in avoided costs that would be necessary to invest in case of direct application the proposals into practice. Designing of ergonomically optimal workplace is based on fundamental principles that take into account the adaptation of work for each employee and for each job role.

1 Introduction

Designing of ergonomic workplaces is engaged in standard DIN 334,000. Objectives within the ergonomic design of workplaces are to create a work space with its equipment, lighting, microclimate that corresponds to the quality requirements for the work of man [9], [10]. Thus designed ergonomic workplace is one of the most important prerequisites for achieving the highest performance of personnel, ensuring its security and promoting its work motivation, which ultimately helps to increase productivity [1], [3]. Designing of ergonomically optimal workplace is based on fundamental principles that take into account the adaptation of work for each employee and for each job role [2], [4].

The ergonomic design of work is based on the following principles:

- anthropometry/industrial anthropometry - the source of the dimensions, mobility and possibilities of load individual parts of the human body such as body weight, height it is part of the scientific discipline of anthropology [11], [12],
- somatography - graphical representation of the human figure in the technical, resp. other

documentation in addressing the dimensional relationship of man and his workplace.

- perimeter - measure the size of the visual field with pinpointing of its borders, physiologically field is an area that can be seen without moving eye.

Simulation support for the ergonomic solution:

- **CAD systems** - allows you to simulate human labour and to design jobs so as to meet the ergonomic requirements in order to minimize the burden of man while maintaining health and safety at work [6], [8]. Some integrated systems provide simple tools for simulation and analysis of the human body, for example Human Builder, Human Measurement Editor, Human Posture Analysis and Human Activity Analysis (features and capabilities of these internal modules are limited), CATIA (allows you to use static analysis of the human body, but dynamic analysis however is not available).
- **Tecnomatix Jack** - complex 3D simulation tool for evaluating the behaviour of man at work, this is the instrument through which it is possible in the virtual environment to design workplace and simulate various solutions that meet ergonomic standards without investing in equipment and technology [13]. Digital

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human model in this program is a real biomechanical properties of natural motion and joint range (taken from NASA studies). Human model is composed of 71 segments and 69 joints, some with more priority and more degrees of freedom, a total of 135 degrees of freedom.

2 Ergonomic analysis in software

Tecnomatix Jack

The aim of implementing or enforcing ergonomic principles should be [5], [7]:

- layout of workplaces and processes to meet requirements for a person's health, safety and comfort do the job,
- maintaining human health and sustainable deploy ability of all employees,
- prevention of overloading staff,
- provide improved satisfaction of workers,
- increase efficiency through ergonomic workplace layout.

Overview of the most commonly used methods:

- Low Back Analysis - evaluates the forces exerted from the spine to the lower back on the virtual human model in every position and in every man's load.
- Static Strength Prediction - detects the percentage of workers who have the power to carry out the work activity.
- NIOSH - a tool for the evaluation of symmetrical and asymmetrical lifting the load.
- Metabolic Energy - the analysis of metabolic energy expenditure - calculated energy consumption of a particular work activity.
- Fatigue Recovery - recovery and fatigue analysis helps us to assess whether the work activity comprising sufficient time to prevent the recovery of the fatigue of the worker.
- Ovako Working Posture Analysis (Owas) Tool - assesses the relative discomfort of man in the working position, emphasis on the position of the back, patio and legs, determines the urgency of remedial action. The method is suitable for analysing posture by performance of work tasks. Assesses the relative discomfort of working position from the position of back, hands, feet and load levels, to the work posture is assigned a number which indicates the urgency to carry out corrective measurement. This measurement is performed to reduce the potential risk of injury to workers.
- Rapid Upper Limb Assessment (RULA) - analysis of the upper limbs, evaluates the working position in terms of diseases of the upper extremities. Rula "is a

survey method for the investigation of work-related upper limb disorders," Applied Ergonomics, 1993

- Manual Handling Limits - it is used for the evaluation of manual handling, helping to reduce the risk associated with back pain, even during lifting, lowering, pushing, pulling and carrying loads.
- Predetermined Time - the time needed to carry out the work activity with distribution of the workload to file motions.

Choosing a suitable method for analysing the optimality of job positions is governed by the results explanatory power from their implementation with regard to potential and real health and safety risks during work (Table 1) [14]. Validating the methods ergonomics intervention selection process is on the figure 1.

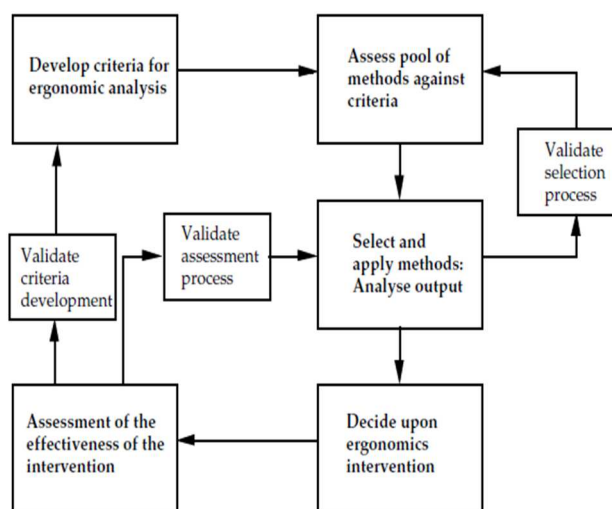


Figure 1 Validating the methods selection ergonomics intervention process. (Adapted from Stanton, N.A. and Young, M.S. [1999], A Guide to Methodology in Ergonomics, Taylor & Francis, London. With permission.)

Below is created a simple workplace in the simulation program TX Jack and are applied methods OWAS and RULA, which help to analyse optimal working postures with an emphasis on upper body (Figures 2-9). These are the most commonly used analysis. This is a load detection of worker by translating the object from the floor to the machine. After the realization of simulation and subsequent completion of the analysis it is clear that the working conditions are not suitable for the protection and safety. Therefore, corrective measures were taken, which consist in the proposal by the conveyor, which significantly reduces the burden on workers at the workplace. This is evident from the realized simulation and subsequent carried out analysis Rula and Owas.

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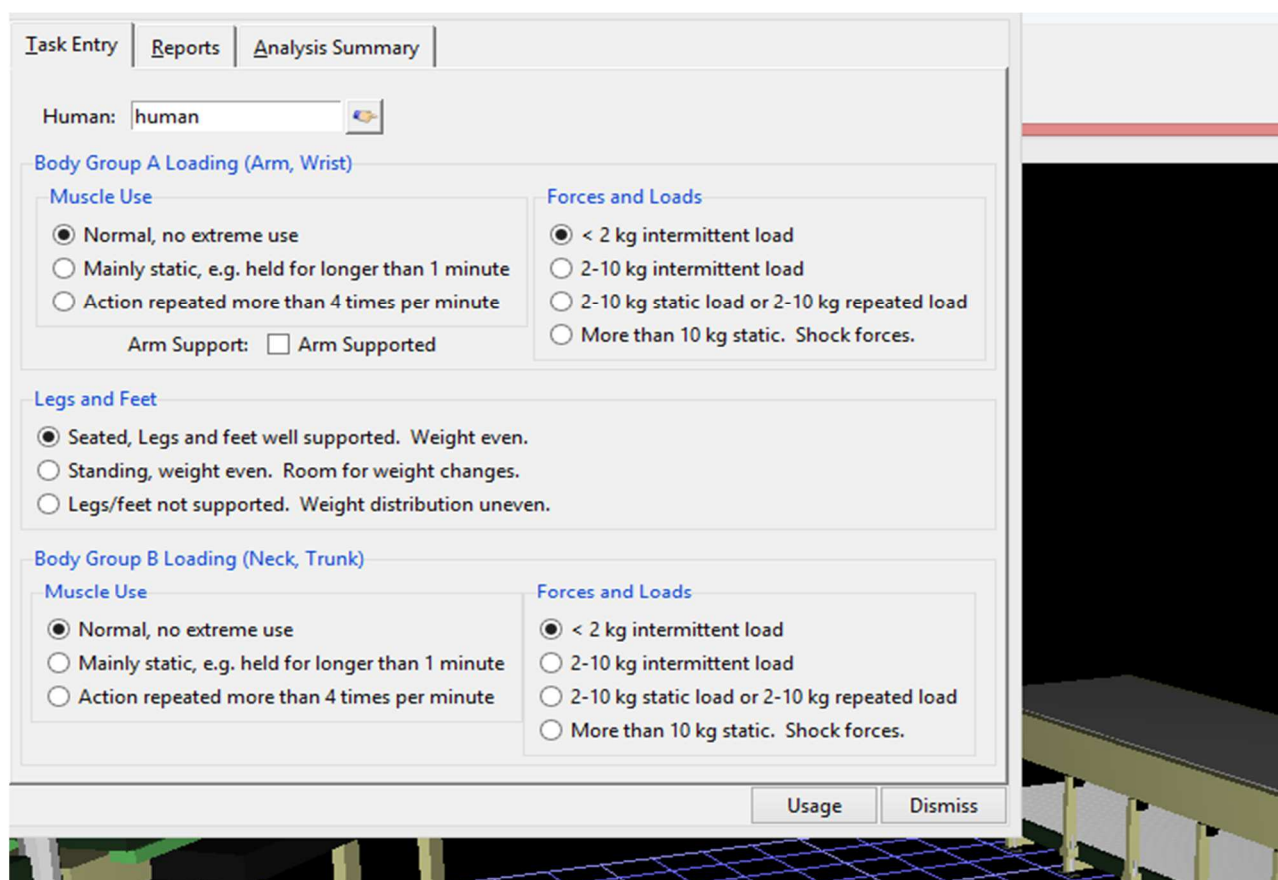


Figure 2 Rula Dialog window

Table 1 Risk category

Risk category	Effects on the musculoskeletal system	Corrective measures
1.	position, which has no harmful effects on the musculoskeletal system	there is no action required
2.	position with the potential to cause damage to the musculoskeletal system	corrective actions are required in the near future
3.	position with harmful effects on the musculoskeletal system	corrective measures are needed as soon as possible
4.	burden caused by this position has an extremely harmful effect on the musculoskeletal system	the need for immediate corrective action

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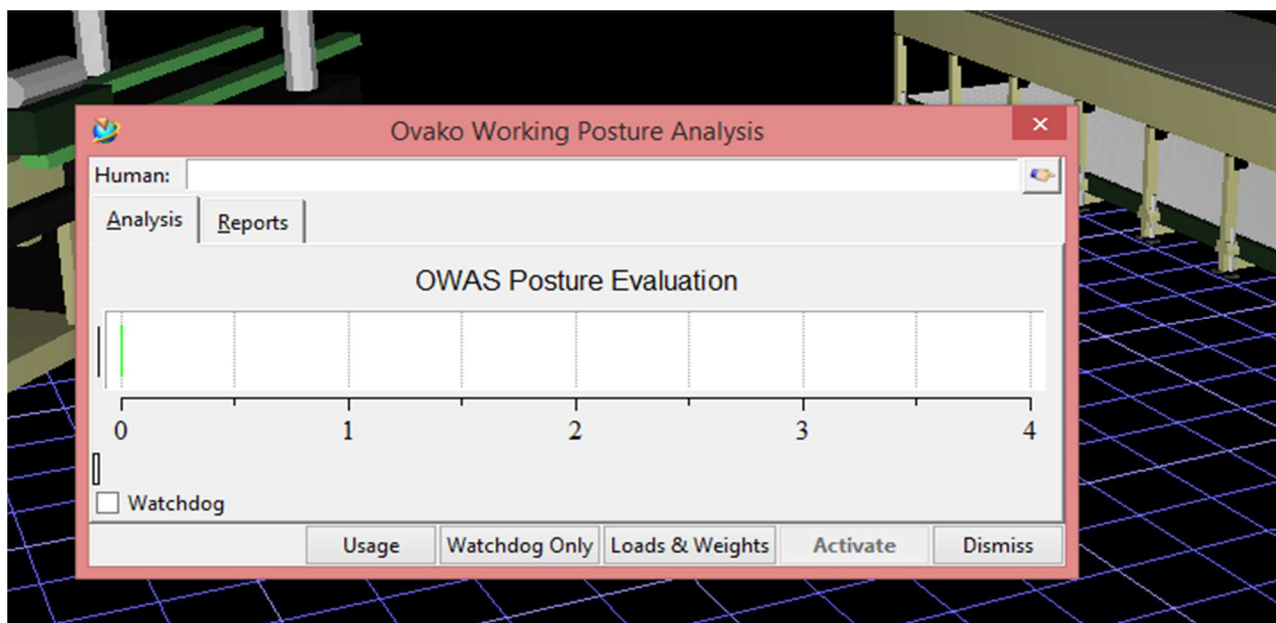


Figure 3 Working Posture Analysis Dialog window

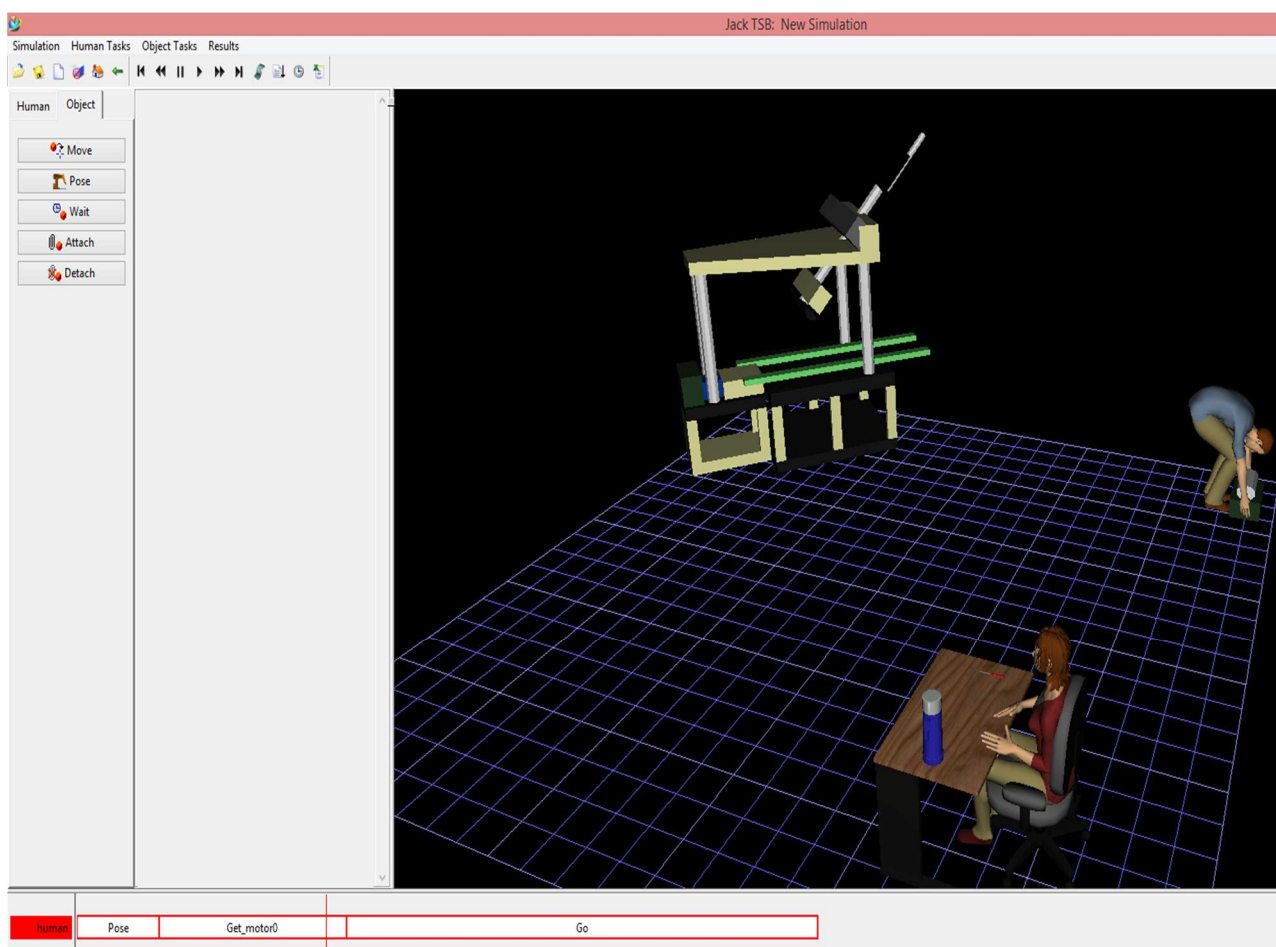


Figure 4 Operating position when lifting the object

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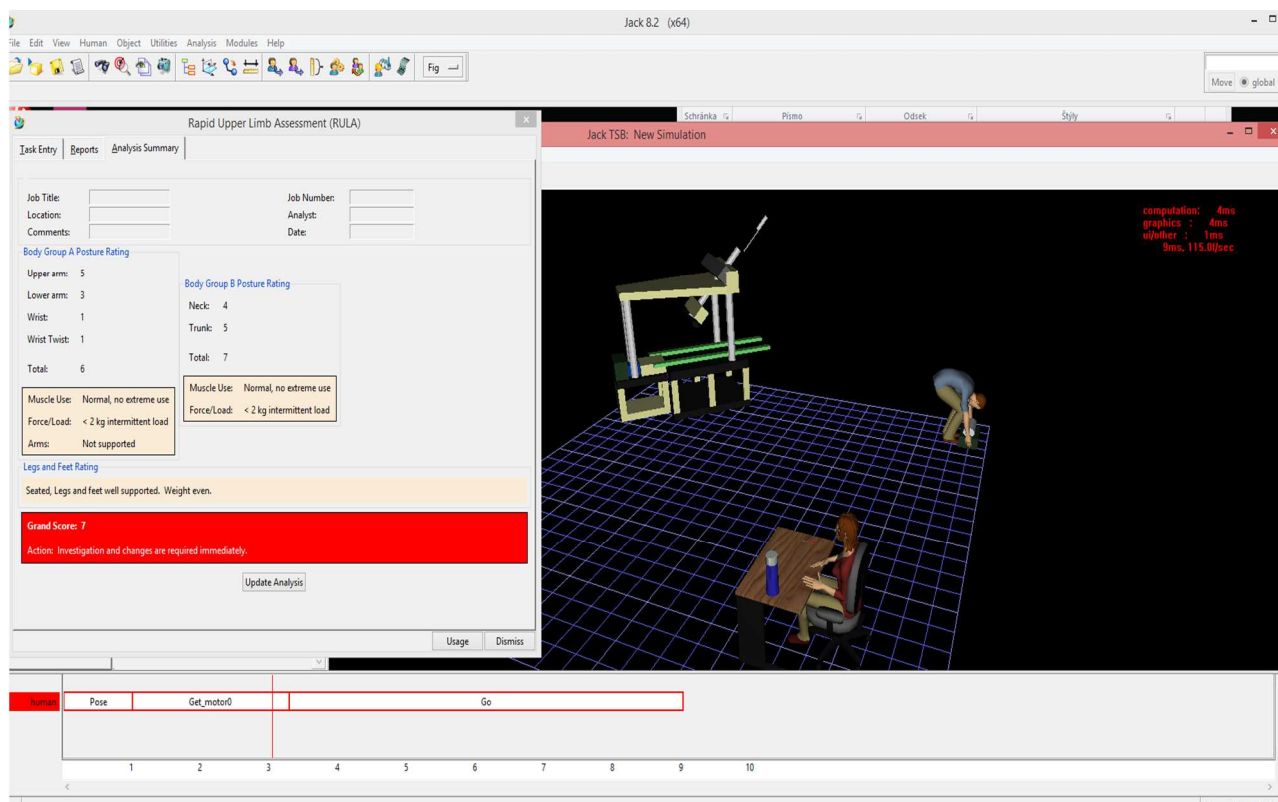


Figure 5 RULA Analysis - Initial Situation

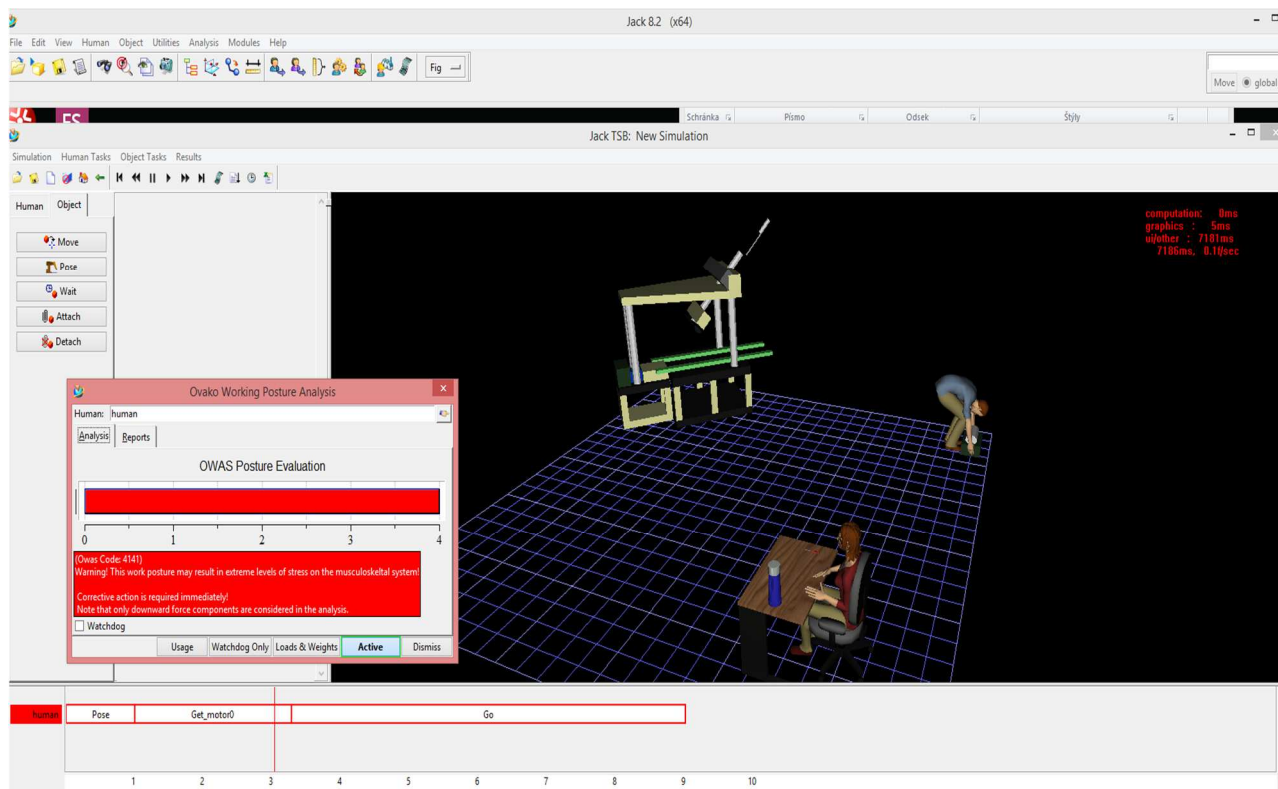


Figure 6 OWAS Analysis - Initial Situation

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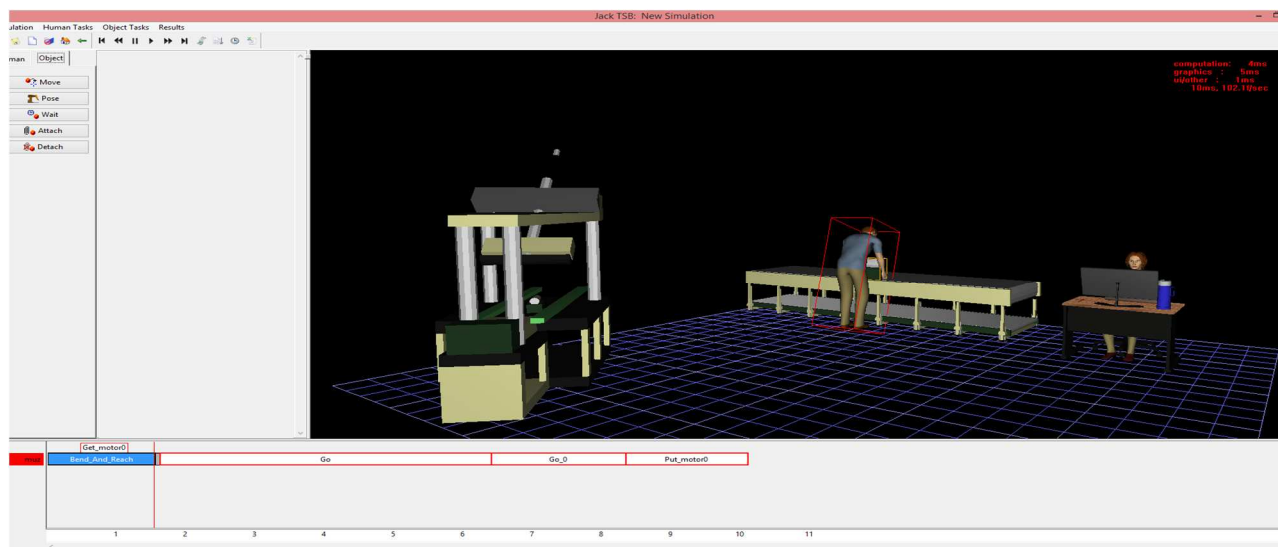


Figure 7 Corrective action in the form of a conveyor

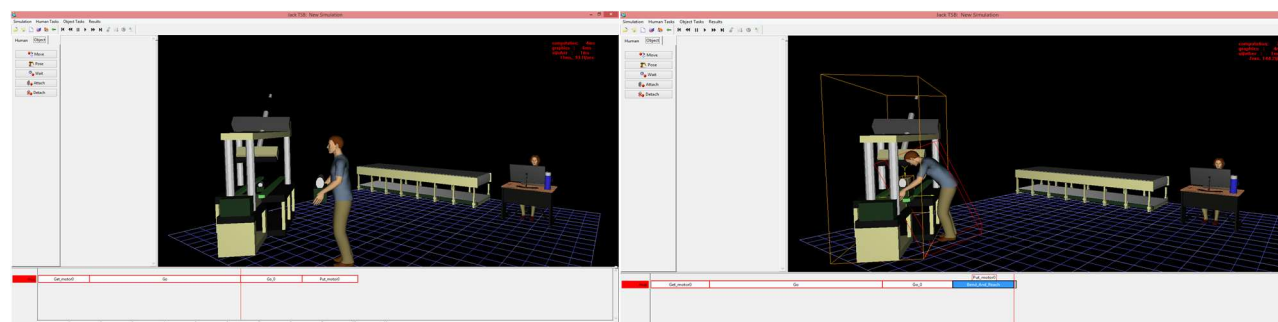


Figure 8 Simulation of transfer of objects from the conveyor to the machine

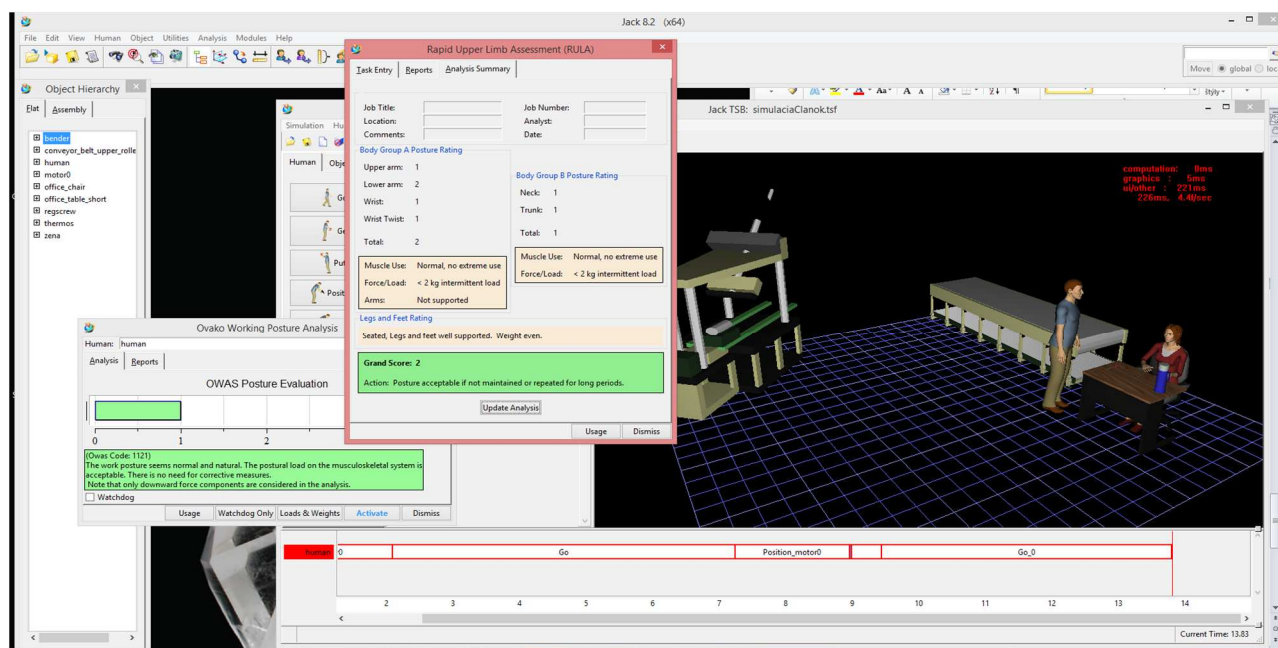


Figure 9 RULA and OWAS Analysis - after the implementation of corrective measures

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Conclusion

The simulation program Tecnomatix Jack is a tool that helps to define the factors that affect job performance and helps to verification of corrective actions in virtual reality. Application of software support creates conditions for experimental verification of various proposals for solutions in a virtual environment. The implementations of measures emanating from the experiment as optimal are easier.

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