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Abstract

The purpose of this project is to apply human factors knowledge and methods to come up with innovative improvement recommendations to a real life operations system with the goal of enhancing the Operational Performance and overall employee wellbeing. A sustainable and efficient work system is based on two major factors. Firstly, caring for employee well-being is important to ensure that the risk of developing musculoskeletal disorders is low, employee absenteeism is low, and that employees are satisfied with their job. The present status of the system was determined using key performance indicators (KPI) of biomechanical loading and psychosocial aspects. The ability to search and find certain tools in the workstation as well as employee satisfaction was used to determine the Operational Performance. The workplace chosen to be investigated and analyzed in this project was High Point Equipment Ltd in Mississauga. They focus on welding, polishing, and manufacturing pharmaceutical equipment. The current workstation will be examined using tools such as a RULA analysis and 4D WATBAK. Using these tools, the loads and current risks of the workstation could be measured and recorded to determine which tasks need to be improved. In addition to these tools, two surveys were also used to measure satisfaction. The chosen surveys were the COPSOQ survey and the NASA Task Load Index (TLX) survey. After utilizing the tools and surveys the results could be analyzed and recommendations and design improvements could be proposed. After determining the improvements, the next step was to evaluate each improvement and re-measure and investigate the loads and risks. In terms of evaluation, the main focuses were effects on the operator, performance, and costs. Once the improvements were recognized as necessary, the general plan was brought up with the workplace itself. The changes in the workstations were mentioned and the overall expected results were also brought up. The workplace agreed that the changes could show significant improvements on employee wellbeing and performance as well as benefiting the company financially in the long-run.

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Methods

System Identification

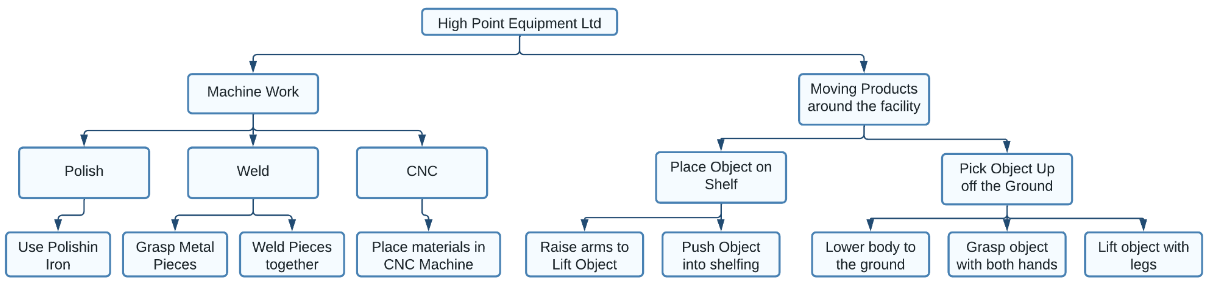

Figure 1: Hierarchical Task Analysis of High Point Equipment Ltd

Using a Hierarchical task analysis (HTA) for the system in place at High Point Equipment Ltd. The group decided on two main tasks that are recurring on the primary workfloor of the plant. These tasks were the welding of metals as well as product movement throughout the facility. The subtasks of the two categories will be investigated further to determine the postures and biomechanical loads produced on the body.

Looking at the category of product movement it can be seen that there are two main tasks within that job. The first is placing an object on a shelf, this is a high reach task that requires the operator to lift an object to a shelf located around or above head level. A rapid upper limb assessment (RULA) can be used to determine if this action is detrimental to the musculoskeletal system. Additionally the other task within this category is lifting an object off of the ground. Given that many of the objects that require lifting can weigh upwards of 20 lbs a 4D WATBAK analysis should be performed in order to obtain the biomechanical loads.

The other category is machine work which encompasses polishing, welding, and CNC machining. These are the most prominent tasks within the facility and this category of tasks contains much more precise and finite movements. The operators must be careful when completing these actions in order to protect themselves and achieve optimal results.

Overall, these two categories are a majority of the workflow within the welding facility and should be investigated separately. Machine work contains more exact movements whereas material movement has much more general full body movement that engages more muscles. Some of the factors that can be looked at within the system that can contribute to the risks within the job include repetitive motions, weight of the objects transported, and workplace equipment and posture.

Data Collection

In order to conduct a risk assessment for MSD, measurements were taken.. These include the employee's postures while performing various duties, as well as measures of their surroundings (e.g. workstation measurements). Photos of the employees executing the job were used to model their posture on 4D WATBAK. Additionally, the RULA will be used to check the load of any high reach tasks Furthermore, several questionnaires and interviews were conducted to analyze the psychological and physiological well-being of the personnel within the working environment. The capacity to search and identify a certain product will be monitored, and customer satisfaction surveys were done, in order to assess the present level of Operational Performance.

Employee Well-Being

Long-term exposure to infrared radiation can cause cataracts by heating the eye's lens. Visible light from welding techniques can overwhelm the iris's ability to limit the brightness of light reaching the retina. Despite the fact that personnel were required to wear protective gear, the illumination in the workplace might induce eye strain as a result of prolonged exposure to certain welding equipment, which generates powerful radiation. Overexposure to bright light may have a negative impact on employees' well-being, affecting how they execute their jobs, the quality of the end result, and operational performance. The illuminance levels would be measured in Lux using a variety of smartphone apps, and an average would be calculated at various points across the system to analyze these risks.

The absence of proper psychosocial support for employees especially in these types of environments could cause higher absence rates and the employees would be more likely to leave their jobs. The cognitive state of the workers is extremely important as it has a huge effect on the way they perform their tasks. The lack of support from management when it comes to employees' cognitive state could cause an increase in staff turnover, workplace conflicts, and physical or emotional stress. A selection of questions from several different scales from the COPSOQ questionnaire were selected and utilized in an interview to assess the employee's current psychosocial and cognitive status [1]. Furthermore, the NASA Task Load Index (TLX) survey was utilized to examine the various demands placed on employees [2]. The answers obtained from these interviews can be found in the Appendix. Observing the employees for an extended period of time and conducting informal interviews about their day to day work revealed the most common postures that the employees experienced. These postures were modeled on 4D WATBAK, RULA, and Snook to determine the extent of the biomechanical loads on the workers and how that would affect their work in the long term.

Evaluation Results

Results on Employee Well-Being

RULA

Table 1: Rula Scores for the high reach task

Activity	RULA Score	Interpretation
High Reach Task - Placing Boxes in Upper Shelf 9.53 kg	Arm And Wrist Analysis - Row in Table C: 7 Neck Trunk & Leg Analysis - Column in Table C : 7 Final Score: 7	Based on the RULA completed for the high reach task, placing boxes in the upper shelf. The final score of 7 demonstrates that the task should be investigated and changed immediately

RULA is an evaluation that can easily and quickly determine if a worker is in a harmful posture [3]. It is an assessment that is very useful when looking at actions that are intensive on the upper body, more specifically the arms and hands. Thus, when using RULA a high reach task should be targeted. As seen in figure _ the task at hand is placing a heavy object on a high shelf which will activate many of the upper limbs in completing the task.

Using the RULA worksheet the high reach task in figure 2 can be analyzed to determine if the task should be investigated and altered to reduce the load on the user. After using the assessment worksheet the final score was calculated to be 7. According to Cornell University this task should be immediately investigated and reworked immediately as it is extremely detrimental to the musculoskeletal system of the operator [4]. There are numerous things that contribute to the high scoring of this task but the most evident ones are the neck, upper arm position and the weight of the object. Both body parts scored the largest in their respective categories, the upper arm was above 90^{o} with raised shoulders giving it a score of +5 and the neck was in flexion increasing the score by +4 respectively. Additionally, the weight of the object, 9.53 kg, increases the total score for each respective category by 2 which leads to a table C score of 7. These three factors resulted in an immense increase to the biomechanical load and an activity that needs to be altered for the operator's safety .

Figure 2: Employee High Reach Task

Snook Tool

Using the Snook Tool, both the high and low reach tasks can be analyzed to determine the maximum acceptable weight (MAW) for the objects being lifted/lowered or carried. The necessary measurements in order to utilize the Snook Tool are as follows: load, hand height, carry distance, box width, vertical lift/lower distance, range of lift, and frequency. After these measurements were obtained the Snook Tool could be used and the results can be seen in the table below.

Table 2: Snook Tool Measurements

Task	Load (kg)	Box Width (cm)	Travel Distance (cm)	Range of Lift	Frequency (#of times/min)
Low-reach	15.29	53 ≅ 79	66 ≅ 76	Floor to Knuckle	5
High-reach	9.53	37 ≅ 49	102 ≅ 76	Arm Reach to Shoulder	5

Table 3: Snook Tool Results

Gender/Task	% of Population	Maximum Acceptable	Load(kg)

		Weight of Lift (kg)	
Male Performing Low-reach	90	14	15.29
	75	20	15.29
	50	27	15.29
	25	34	15.29
	10	40	15.29
Female Performing Low-reach	90	8	15.29
	75	10	15.29
	50	12	15.29
	25	14	15.29
	10	16	15.29
Male High-reach	90	12	9.53
	75	17	9.53
	50	22	9.53
	25	27	9.53
	10	31	9.53
Female High-reach	90	8	9.53
	75	9	9.53
	50	11	9.53
	25	13	9.53
	10	15	9.53

After utilizing the Snook Tool on both the low and high reach tasks, the results were examined. Both tasks exclude a certain group at one point, although the low reach task struggled more with including a high percentage of the population. When reviewing Table 3, it can be seen that the current load for the low reach task excludes 10% of the male population and 75% of the female population. Alternatively, for the high reach task, the male population is not excluded at all and 25% of the female population is excluded. Overall, both tasks should be redesigned in ways to minimize the lift distances and increase the MAW.

Results on Operational Performance

4D WatBak

The 4D WATBAK software allows for the analysis of a task using a digital simulation of a human being. After taking into account the simulated human's age, weight, height, sex, and any other loads they may be carrying, the software calculates the biomechanical stress they experience. The following moments and forces were determined as a result of the WATBAK analysis of the original design:

User is 47 years old, 175 cm, 81 kg, Load is 15.29 kg

Table 4:WATBAK Results of Original Design Low Reach Task

L4-L5 Moment	L4-L5 Compression	Reaction Shear	Joint Shear	R shoulder flexor/extensor	L Shoulder flexor/extensor
199.7 Nm	3517 N	516 N	1265.5 N	14.4 Nm	14.4 Nm

A WATBAK analysis was performed for the low-reach task. The spine compression and spine joint shear both exceed the allowed limits; the spine joint shear is significantly above the maximum permissible limit. This task needs immediate attention and to be improved as soon as possible. The spine compression is 3517 N, above the allowed limit of 3433 N by only 84 N, but continued and repetitive assumption of this posture will eventually become detrimental. The spine joint shear loading is in dire need of improvement. The spine joint shear is 1266 N, significantly above the maximum permissible limit of 1000N. Spinal loading needs to be reduced significantly because these postures and stress are unsustainable, all users are at risk for developing MSDs.

Figure 3: Employee Low Reach Task

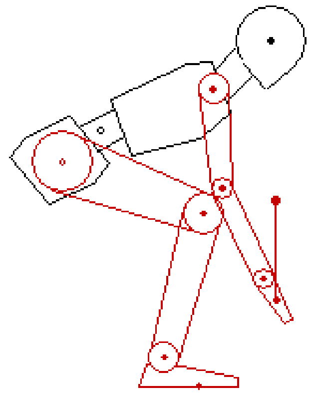

Figure 4: Low Reach Task WATBAK Digital Human

Design Improvements & Recommendations

Recommendations

The design improvements and recommendations will be based on different theories and models that were learnt in class including Reason's Error Model and the 13 Design Principles. The main purpose of the suggestions made is to decrease the biomechanical loads that the workers experience, improve the psychosocial and cognitive function of the job, and enhance the quality of operational performance. However, due to COVID-19 restrictions the design improvements and recommendations were not able to be implemented fully. Despite this, data analysis was conducted based on the theoretical addition of the suggested improvements to understand how these changes would impact the overall system.

Employee Well-Being Improvements

Biomechanical Load Improvements

Figure 5: Folding Stepping Stool [5]

According to figure 5, the employee must reach a box that is approximately a wingspan's length above his shoulders which hinders the quality of work. The RULA score assessed the task to be highly dangerous and should be investigated immediately. After conducting a few assessments based on the work environment along with the COPSOQ survey a solution was implemented. The improvement included a heavy duty stepping stool that would allow the worker to reach the box while relieving the prior stress on the shoulders and the neck of the employee. The weight of the box is relieved by allowing the employee to carry the box closer to his chest instead of an over-body carrying angle. The implementation of a stepping stool will allow the biomechanical load to decrease and reduce the possibility of MSD's within the task.

In addition, a theoretical RULA (table 5) was done to see if using a stepping stool made a difference in the workers' ability to execute the high-reach activity. If the worker uses the stool to set the object at chest height, the upper arm's score will drop dramatically since the shoulder won't be elevated and won't be over 90 degrees. The arm and wrist analysis will receive a score of 4 as a result of this. Furthermore, with the addition of the stepstool, the neck will no longer be fully extended, but will instead be angled forward at a 10-20 degree inclination. This will bring the score for the neck, trunk, and legs down to a 4. As a result, the total score is 4, a huge improvement from the prior score of 7. The weight of the object is one factor that has a significant impact on the scoring. Despite the fact that the score was significantly decreased, the object's weight might be exceedingly harmful to the worker in the future. Overall, the step stool is a great recommendation for the workers as it will increase efficiency by making it easier to execute the task, and improve worker wellbeing by reducing the physical load during the duration of the task.

Table 5: Hypothetical RULA of Improvements

Activity	RULA Score	Interpretation
High Reach Task - Placing Boxes in Upper Shelf 9.53 kg	Arm And Wrist Analysis - Row in Table C: 4 Neck Trunk & Leg Analysis - Column in Table C : 4 Final Score: 4	Based on the RULA completed for the high reach task, placing boxes in the upper shelf. The final score of 4 demonstrates that the task should be investigated

Psychosocial State Improvements

To improve overall user safety the use of welding gloves will drastically increase the state of ease that is not seen in a high-paced, dangerous environment. Employees' mental state will be more stable as they will be less preoccupied with factors that may hinder their working conditions. According to the COPSOQ survey (can be viewed in appendix), the quality of satisfactory work completed is average and can be further improved by the implementation of safety gloves. This will reduce the possibilities of cuts, scrapes and other nerve compression syndromes. Due to the demographic of the age of employees working at the company, an increase in nerve/tissue damage accumulating over the years will cause employees to take off more days due to the stress. The heavy duty safety gloves are only functional prior to exposure to safety dangers as a prophylactic step to prevent injuries. These gloves provide hand flexibility as well as protection from electrical shock, extreme heat, UV and infrared radiation, abrasion resistance, and improved grip.

Figure 6: Heavy Duty Safety Gloves [6]

Figure 7: Polishing/ Welding Task (No Gloves)

Welding gloves come in a range of materials, each of which addresses a particular problem. MIG welding gloves, which will be utilized in this particular workspace, provide a high level of protection against metal scraps, intense heat, sparks, and harmful spatters[7]. MIG welding gloves are often made of cow split/grain and goat lines, both of which are thicker than other welding gloves. When compared to stick welding, TIG welding, and cut-resistant gloves, MIG welding gloves are believed to be more robust and durable[7]. Extra leather on the thumb, index finger, and metacarpus region of the hand. The welding glove's durability is increased by using Kevlar seams.

Operational Improvements

Another issue arised from investigating the handling of materials and moving boxes around at low reach tasks. The worker's carried hefty boxes around at regular intervals of every 5 minutes or so and after some investigation the biomechanical load on the worker's yielded dangerous results to the musculoskeletal system of the worker. As shown in section_(4DWatbak), the image taken was simulated and resulted in the spine compression/ joint shear values exceeding their respective limits. To counteract this, an improvement to the task was suggested, a stalwart trolley. The robust trolley, shown in figure_ has a load capacity of 245kg which provides ample size for the boxes to be placed and maneuvered easily.

Figure 8: Stalwart Trolley [8]

The trolley will allow for multiple items to be maneuvered around the workplace as each item(s) weigh approximately between 9kg-15kg. The worker will theoretically be able to carry 100kg-150kg safely on the trolley without having adverse effects on the spinal region. Also, an increase in efficiency will likely be seen within the workspace as workers are able to maneuver the boxes around without exerting massive amount of energy in reaching down and compressing their spine as per table_2 in which the spinal compression is listed at a wapping 3517 N and a joint shear of 1265.5 which will be reduced decreasing the long term possibilities of MSD's. The trolley also has 360° turning wheels which will lower the torque and L4-L5 Moment values listed in table_2. By implementing the trolley the workspace will witness decreases in the postural stress, lower back muscle activity, compression, and force exertion on each worker maneuvering items [9]. On the other hand, there will be risks associated with the addition of the trolley. Firstly, items will need to be secured and fastened to the trolley to avoid damage of items and injuries stemming from accidents such as trips and falls while moving the trolley. The increase in musculoskeletal stress in the hands might create other opportunities for MSD's to arise if precautions are not implemented.

Cost of Improvements

There are a total of nine personnel in the workstation who must be able to fully utilize the system enhancement items. The majority of the items will be used by the 6 CNC workers who are using heavy duty machines and transporting items around the workstation. Welders and polishers, on the other hand, will share their products because they work in a more employee-friendly environment than CNC workers. Employees will, however, each receive their own pair of safety gloves to safeguard their wellbeing as the risk of injury grows around hazardous machinery.

Table 6: Item Costs Summary for Operational Performance Improvements

Item(s)	Quantity	Estimated Costs/ Item
Stepping Stool	3	$34.99 x 3 = $104.97
Stick Welding Gloves	9	$25.49 x 9 = $229.41
Trolley	3	$92.01 x 3 = $276.03

Estimated Costs (Tax Included)= ($104.97+ $229.41+ $276.03)* 1.13= $689.76

The improvements will come at a one time cost of $689.76. Regarding the possible improvements in revenue for the company there is not enough data as the solution has not been implemented and therefore no cost assessments can be made.

Discussion & Conclusions

The team spent the semester gathering vital information from High Point Equipment Ltd to be able to conduct human factor analyses and investigations to reach the goal of improving operational performance and employee well-being. WATBAK, RULA assessment, and Snook Tool were used to analyze and study the different postures of the employees and calculate the L4-L5 moment, L4-L5 compression, joint shear, reaction shear and maximum acceptable weight of lift. According to the 4D WATBAK analysis, it was found that the posture used in the original design of the task undoubtedly puts the user at immediate risk for MSDs. The inclusion of a stepping stool, welding gloves, and a trolley to transport materials significantly improved biomechanical loading. When all of these suggestions are used in combination, the results are shown in a significant reduction in compression, moment, shear spinal loadings and an increase in maximum acceptable weight of lift. To improve the employee well-being, posture changes were recommended and remodeled on WATBAK and RULA to assess the changes in biomechanical loads and how that would affect the workers performance.

References

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Appendix

COPSOQ Survey Questions and Answers Before:

- Cognitive Demands
  - Do you have to keep your eyes on lots of things while you work? **Often (75)**
  - Does your work demand that you are good at coming up with new ideas? **Sometimes (50)**
- Emotional Demands
  - Does your work put you in emotionally disturbing situations? **Sometimes(50)**
  - Do you have to deal with people's personal problems as part of your work? **Never/Hardly ever (0)**
- Quantitative Demands
  - Is your workload unevenly distributed so it piles up? **Often (75)**
  - Do you have enough time for your work tasks? **Sometimes (50)**
- Work Pace
  - Do you have to work very fast? **Always (100)**
  - Do you work at a high pace throughout the day? **To a large extent (75)**
- Possibilities for Development
  - Do you have the possibility of learning new things through your work? **Somewhat (50)**
  - Does your work give you the opportunity to develop your skills? **To a large extent (75)**
- Recognition
  - Is your work recognized and appreciated by the management? **Somewhat (50)**
  - Does the management at your workplace respect you? **To a large extent (75)**
- Quality of Work
  - To what extent do you find it possible to perform your work tasks at a satisfactory quality? **SOMEWHAT (50)**
  - Are you satisfied with the quality of the work performed at your workplace? **SATISFIED (75)**
- Role Clarity
  - Does your work have clear objectives? **TO A LARGE EXTENT (75)**
  - Do you know exactly which areas are your responsibility? **TO A LARGE EXTENT**
- Work Engagement
  - How often do you experience the following?
    - At my work, I feel bursting with energy. **SELDOM (25)**
    - I am enthusiastic about my job. **SOMETIMES (50)**
    - I am immersed in my work. **ALWAYS (100)**
- Job Satisfaction

- Regarding your work in general. How pleased are you with
    - your work prospects? **SATISFIED (75)**
    - the physical working conditions? **UNSATISFIED (25)**
    - the way your abilities are used? **SATISFIED (75)**
    - your job as a whole, everything taken into consideration? **SATISFIED (75)**
    - your salary? **NEITHER/NOR (75)**

NASA Task Load Index (TLX) Survey

The task selected was welding a metal piece together:

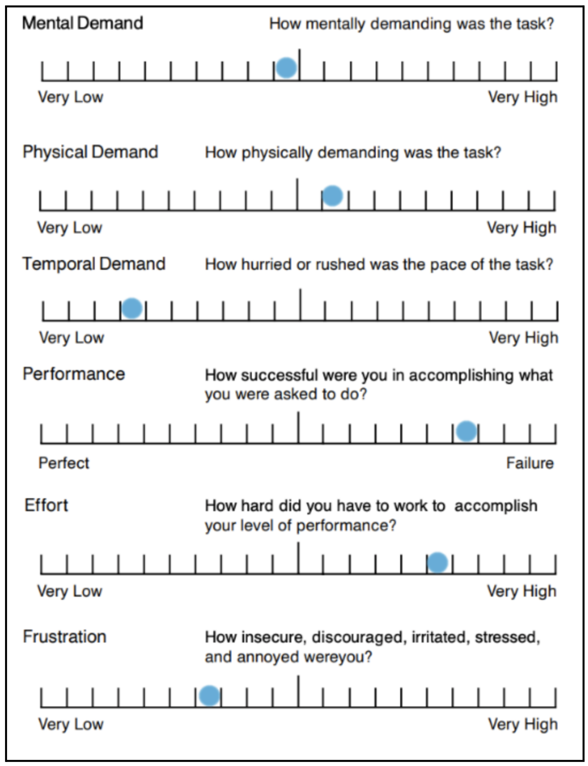

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Figure 9: NASA TLX survey for welding

The task selected was lifting a box from a low reach to a high reach area:

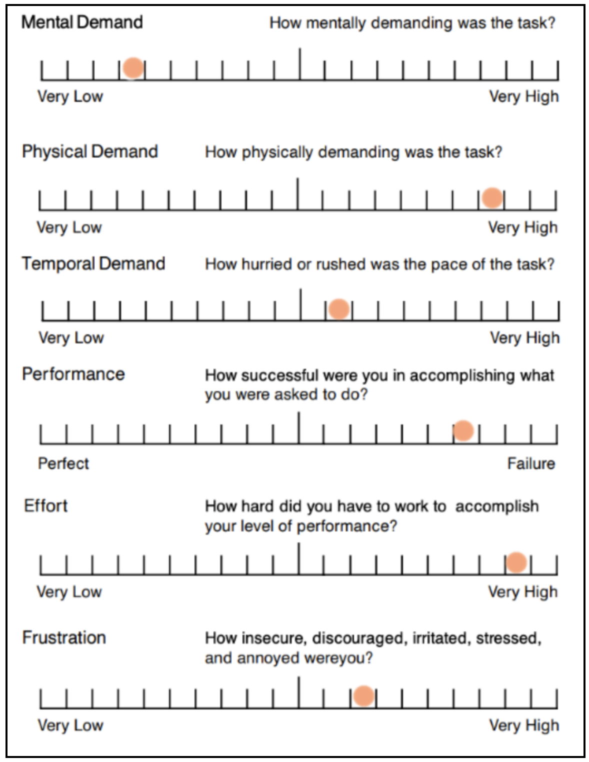

Figure 10: NASA TLX survey for lifting box

WATBAK

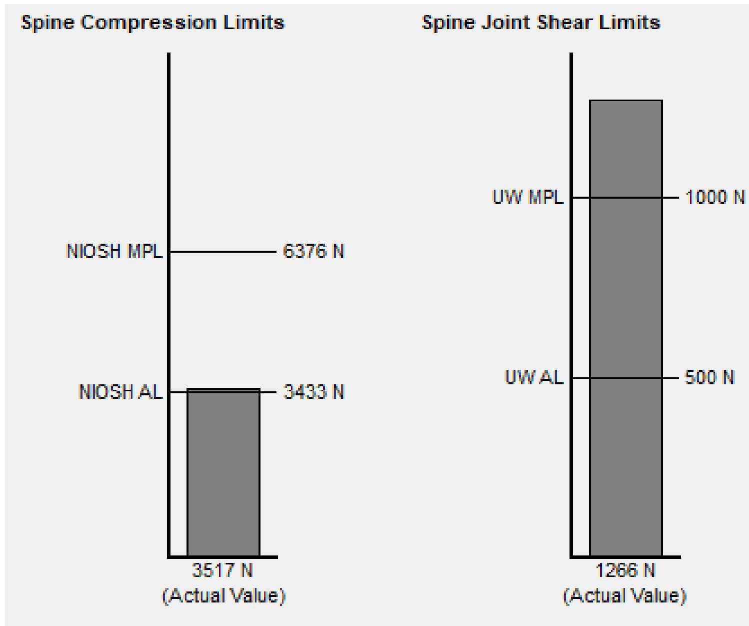

Figure 11: Low Reach Spinal Compression and Shear Loading

Joint Moment Strength Data

Joint		% of Population Not Capable	Calcuated Moment (Nm)
R Elbow	Flexor/Extensor	0.1	11.8 FL
	Supinator/Pronator		0.0
L Elbow	Flexor/Extensor	0.1	11.8 FL
	Supinator/Pronator		0.0
R Shoulder	Flexor/Extensor	0.1	14.3 FL
	Internal/External Rotator		0.0
	Abductor/Adductor		0.0
L Shoulder	Flexor/Extensor	0.1	14.3 FL
	Internal/External Rotator		0.0
	Abductor/Adductor		0.0
Lumbar	Flexor/Extensor	0.1	199.7 EX
	Right/Left Twist		0.0
	Right/Left Lateral Bend		0.0
		25%	

Figure 11: Low Reach Joint Moment Strength Data

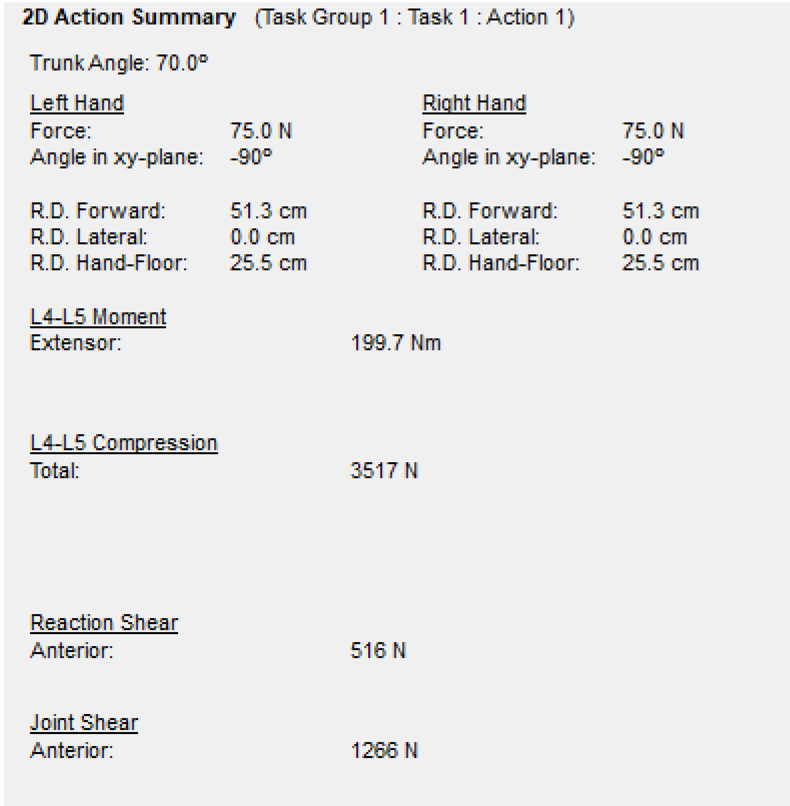

Figure 12: WATBAK Analysis Results

Snook Tool

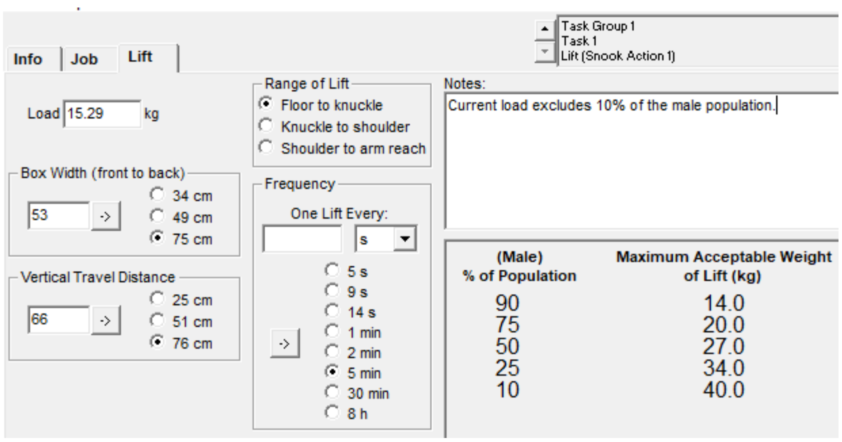

Figure 13: Snook Tool Results for Male Performing Low Reach Task

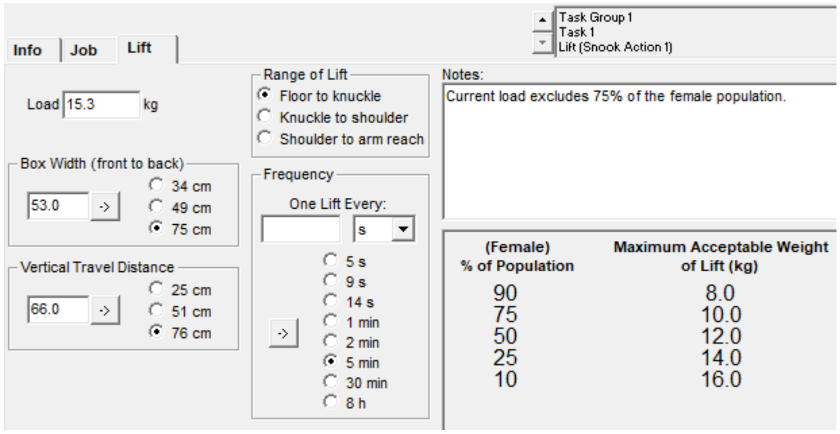

Figure 14: Snook Tool Results for Female Performing Low Reach Task

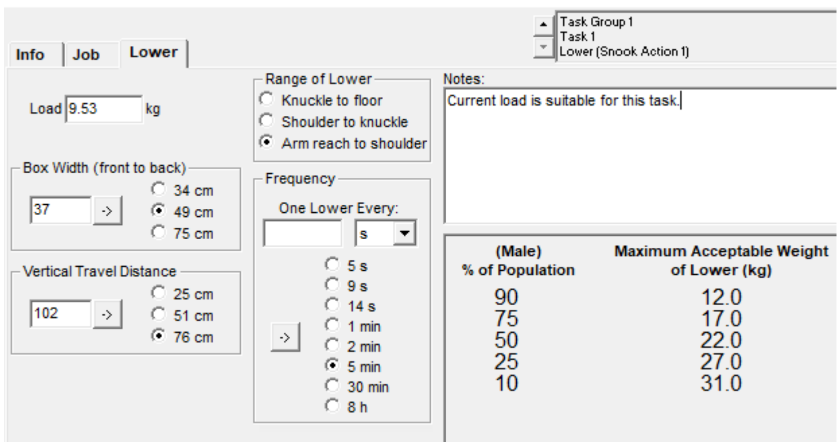

Figure 15: Snook Tool Results for Male Performing High Reach Task

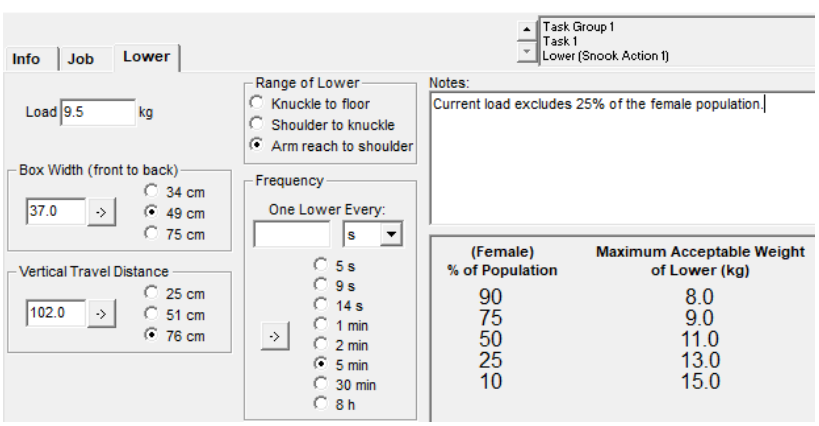

Figure 16: Snook Tool Results for Female Performing Low Reach Task

IND712 Term Project Work breakdown Form

Each team must submit 1 Work breakdown form with their projects
I hereby confirm that the work breakdown specified below is a fair representation of the work performed by each of the team members. I am aware that mis-representing the work of myself or another student constitutes an Academic Misconduct Violation under Ryerson's Policy 60: *Student Code of Academic Conduct.*

Student name (print) & ID (last 4 digits)	Signature
1. Mohamed Ismail	M.I.
2. Ibrahim Abukar	I.A
3. Kobe Tang	K.T
4. Alan Luc	A.L
5. Aidan Harner	A.H

Use the table below to outline each team member's primary and secondary responsibilities in the submitted project. (multiple students can take primary/lead responsibility for the same work if the work is shared evenly – please note this as 'shared'). Form may go to 2 pages if needed.

Student Name &ID (last 4 digits)	Specify Lead, secondary (2nd) or 'shared' responsibility Use as many lines as required to explain the contribution of each team member.
Mohamed Ismail xxxxx4445	**Site Identification** ● Seeked a location that would house the study - <u>Shared</u> **Proposal** ● Wrote ○ Indicators and Methods Section - <u>Shared</u> ● Brainstormed Ideas for evaluation - <u>Shared</u> **Progress Report** ● Wrote ○ Data Collection & Methods - <u>Lead</u> ○ Preliminary Results & Progress - <u>Secondary</u> ● Proofread/Edit - <u>Shared</u> **Final Report** ● Conducted interviews with employees using COPSOQ questionnaire - <u>Shared</u> ● Conducted interviews with employees using NASA TLX Survey - <u>Shared</u> ● Took pictures of employees at workplace - <u>Secondary</u> ● Wrote ○ Abstract - <u>Shared</u> ○ Data Collection - <u>Lead</u> ○ Psychosocial Improvements - <u>Shared</u> ● Formatted Slides / Report - <u>Shared</u>

Kobe Tang
xxxxx2757
	Site Identification
	● Seeked a location that would house the study - Shared
	Proposal
	● Wrote “Site” section - Lead
	● Proofread/Edit - Shared
	● Brainstormed Ideas for evaluation - Shared
	● Responsible for submitting deliverables - Lead
	Progress Report
	● Wrote
	    ○ Hazards Identified & Areas of Concern - Lead
	    ○ Overview of System under study - Lead
	● Responsible for submitting deliverables - Lead
	Final Report
	● Created HTA for system under study - lead
	● Communicated with place of study to create a timetable for visits - shared
	● Wrote
	    ○ System Identification Section - Lead
	    ○ Biomechanical Load Improvements - Shared
	    ○ Evaluation Results (RULA) - Lead
	● Used RULA to assess High Reach task - Lead
	● Formatted Slides / Report - Shared
	● Responsible for submitting deliverables - Lead

Ibrahim Abukar
xxxx68655
	Site Identification
	● seeked a location that would house the study - Shared
	Proposal
	● Wrote
	    ○ Outcomes - Lead
	● Proofread/Edit - Shared
	● Brainstormed Ideas for evaluation - Shared
	Progress Report
	● Wrote
	    ○ Challenges Experienced & Plan for Completion - Lead
	    ○ Preliminary Results & Progress” - Lead
	Final Report
	● Conducted interviews with employees using COPSOQ questionnaire - Shared
	● Conducted interviews with employees using NASA TLX Survey - Shared
	● Wrote
	    ○ Operational Improvements - Lead
	    ○ Biomechanical Load Improvements-Shared
	    ○ Psychosocial Improvements - Shared
	    ○ Cost Of Improvements- Lead
	● Formatted Slides / Report - Shared

Aidan Harner
xxxx99807
	Site Identification
	● seeked a location that would house the study - <u>Shared</u>
	Proposal
	● Wrote
	    ○ Next Steps - <u>Lead</u>
	● Proofread/Edit - <u>Shared</u>
	● Brainstormed Ideas for evaluation - <u>Shared</u>
	Progress Report
	● Wrote
	    ○ Further Analysis Methods - <u>Lead</u>
	● Proofread/Edit - <u>Shared</u>
	Final Report
	● Used Snook Tool for evaluation - <u>Lead</u>
	● Communicated with place of study to create a timetable for visits - <u>shared</u>
	● Wrote
	    ○ Evaluation Results (Snook Tool) - <u>Lead</u>
	    ○ Abstract - <u>Shared</u>
	    ○ Cost Of Improvements- <u>Secondary</u>
	    ○ Discussion & Conclusions - <u>Secondary</u>
	● Formatted Slides / Report - <u>Shared</u>

Alan Luc
xxxx50426
	Site Identification
	● seeked a location that would house the study - <u>Shared</u>
	Proposal
	● Wrote
	    ○ Indicators and Methods- <u>Shared</u>
	● Proofread/Edit - <u>Shared</u>
	● Brainstormed Ideas for evaluation - <u>Shared</u>
	Progress Report
	● Wrote
	    ○ Possible Improvements - <u>Lead</u>
	● Proofread/Edit - <u>Shared</u>
	Final Report
	● Used 4D WATBAK for evaluation - Lead
	● Took pictures of employees at workplace - <u>Lead</u>
	● Wrote
	    ○ Introduction - <u>Lead</u>
	    ○ Evaluation Results (4D Watbak) - <u>Lead</u>
	    ○ Discussion & Conclusions - <u>Lead</u>
	● Formatted Slides / Report - <u>Shared</u>