HEX-Cap: Hexcel Ergonomic eXperience Capstone

UNIVERSITY of WASHINGTON

HEXCEL

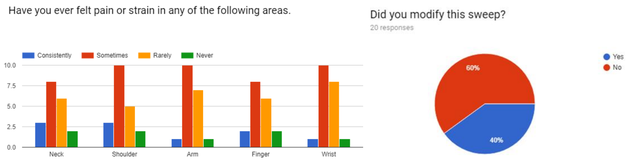
Background

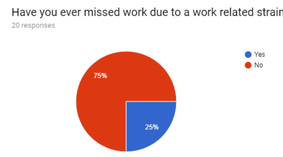
- Hexcel is a leading carbon fiber manufacturer, specializing in composite parts for aerospace manufacturers.

Problem

- Poor lamination hand tools were resulting in workplace injuries
- New tool designs were commissioned to improve ergonomics
  - This required the development of objective measurements to evaluate ergonomic improvement

Survey Results





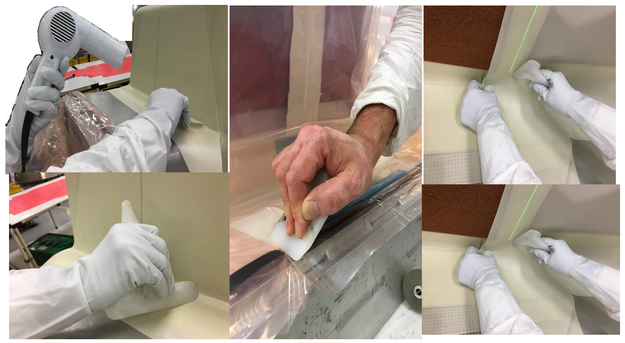
Economic Impact of Carpal Tunnel Syndrome

- About 1/3 of employers are self-insured in the state of Washington. Meaning they handle and pay work related injury claims.
- Carpal Tunnel sufferers miss twice as much work (***138 days vs. 46 days***) and file nearly twice as many claims per year(***4443 vs 2544***) than upper extremity fractures.
- An average loss of earnings per claimant can range from ***$45,000*** to ***$89,000*** over 6 years.

Source: Foley, M. and Silverstein, B. (2015), The long-term burden of work-related carpal tunnel syndrome relative to upper-extremity fractures and dermatitis in Washington State. Am. J. Ind. Med., 58: 1255-1269. doi:10.1002/ajim.22540

Developing Ergonomic Metrics

Phase 1: Monitoring Employee Processes



Phase 2: Incorporating Sensors

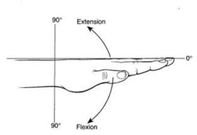
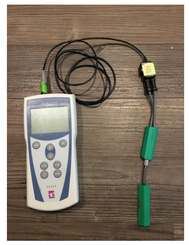


Figure 1: Wrist Flexion/Extension

Figure 2: Electrogoniometer



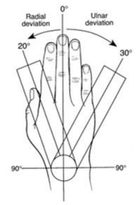


Figure 3: Radial/Ulnar Deviation

Figure 4: Wrist in Neutral Position

Figure 5: Wrist Flexion

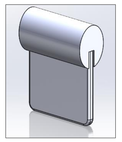
Phase 3: Developing a Standardized Procedure

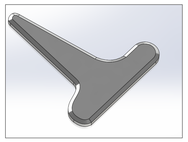
- Workers were instructed to try laminating 5 surfaces with each of the test sweeps
- Mold design was created to emulate standard working conditions

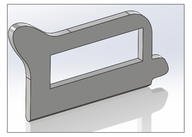
Sweep Creation

Phase 1: 3D CAD Modelling

For quick visualization and conceptual design, 3D computer-aided design models were created in Solidworks.

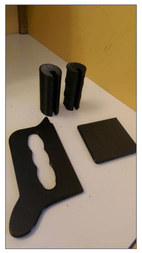






Phase 2 : 3D Printing

From the 3D CAD models, physical prototypes were created using PLA filament. Unfortunately, the 3D printed sweeps are not approved for direct use in the actual lamination process..



Phase 3 : Machining Process-ready prototypes

Taking into account recommendations and comments, the next iteration of prototypes were manufactured using lamination process-approved HDPE plastic.

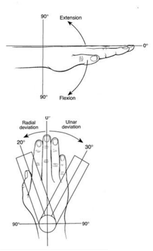
Vertical Handle Sweep

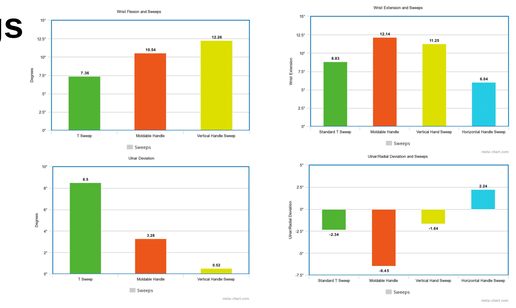
Bagging Sweep

Moldable Handle Sweep

Horizontal Handle Sweep

Numbers/Findings





Conclusions

- HEX-Cap parallel handle sweep minimized wrist extension leading to improved ergonomics.
- Experienced employees will require a training period to see benefit from new sweep designs.

Moving Forward

- Foster employee buy-in for new sweeps and practices
- New employees should immediately start using new sweep designs.