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PhD in Industrial Engineering/ Biomechanics at the University of Miami. Damon works in the Constellation Ground Operations Project (GOP) office and has worked in the Space Station Program within the Orbiter Space Plane Project, and the Space Shuttle Program at KSC. In each of these, Damon was involved with process improvements for existing or future ground crew operations, i.e., assembly, maintenance, and inspection of flight hardware.

Inside this issue:

Human Factors for Optimal Operability of Constellation Ground Systems

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Since the beginning of the Constellation Program, the requirements for ground processing human factors have been developing and documented for Flight Hardware, Ground Support Systems (GSS) and Ground Support Equipment (GSE). Thus, all areas are leveraging human factors for optimizing ground processing operability of Flight Hardware and Ground Systems. Aspects that helped promote an emphasis on the GSE and GSS human factors requirements were; the CxP previously accepted ground assembly and maintenance human factors requirements for designing flight hardware, leveraging past lessons learned from the Space Shuttle and Space Station Programs and building on successes as the CxP Program evolved [1, 2, 3 & 4].

Key KSC human factors concerns were pilot tested through human factors engineering design workshops [5]. This process was effective in identifying the major human factors concerns for these designs. In addition, human factors stories of past operator experiences were collected, documented, and used to verify or improve the key human factors requirements.

From a flight hardware ground processing aspect, work is already progressing in many areas. One such area is the motion capture work performed at the United Space Alliance's Human Engineering and Modeling and Performance Lab at KSC to improve design the CEV vehicle [6]. There is a great benefit of using human factors to improve operations, as the article states, "This is how the techniques for assembling the Orion spacecraft are devised, not by trial-and-error inside a multi-million-dollar capsule, but by computer in a virtual world where no one can drop a life support system on their toe or wrench their back while moving equipment inside."

From a GSS, GSE aspect, as was mentioned previously, human factors workshops were performed on GSE and GSS systems designs. This work has lead to a simple, efficient, and adequate process for proactive evaluation of designs for the 30% design package. This process basically involves one or more experienced human factors personnel with flight hardware processing experience using a worksheet to determine the key human factors concerns for each design.

From a planning aspect, the human factors section in the GOP L3 SEMP (GS Level-3 System Engineering Management Plan) outlines all areas effecting ground processing, and also explains that the lower levels should do a human factors assessment.

The KSC Human Factors Assessment Tool is in development and testing as a tool that can help the designer find the associated standards for the key KSC human factors areas of concern.

Future plans are; (1) to leverage the use of human factors to improve design for operability for both flight hardware processing and ground systems maintenance and refurbishment activities, (2) to develop and refine the human factors engineering tool, human factors requirements, and related processes, (3) and employ the human factors systems engineering processes and lessons learned from Ares-I to improve the requirements, tools, and processes for Ares-V [7].

In conclusion, the original approach for developing the human factors requirements for the GOP GSS and GSE, was to use the methodology for designing flight hardware for ground processing, (i.e., a small set of key human factors requirements with verification requirements). Through the systems engineering process and experienced leadership in the GOP, adjustments were made so the requirements and the implementation of the requirements would be of most benefit to the designers and final design.

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Situational Awareness (SA) - More Important Than Ever

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Situational Awareness (SA) is the continuous ability of the team, acting as a single entity, to *accurately* perceive the relationship of themselves and their surroundings. Situational Awareness has been said to be a factor in all mishaps. Key "piece(s) of the puzzle" were unavailable to some team members to a degree sufficient to cause the event.

Persons often have acted incorrectly (or *failed* to act correctly) based on an inaccurate perception of an unfolding situation. In a sense, these individuals "solved the wrong problem." Their "good faith" responses caused or contributed to a mishap; or, at very least, prevented mitigation of an event's effects. Hazards to personnel and damage to hardware were often the consequence.

A particularly insidious and potentially dangerous variation can be seen in those instances when a non-conformance that occurs during an operation (e.g., loss of electrical power; no air/lighting available, etc.), *is rapidly corrected within moments* by a simple switch reset or valve adjustment, and the operation is allowed immediately to resume. Analysis of these events often reveals that there were more complex, underlying causes/contributors at work that the "corrective" action actually masked. Additionally, the apparent problem may have been only a single step in a series of steps (e.g., Pre-operations setups) which remained undone and undiscovered as the operation resumed/continued.

In the USA "Spaceflight Resource Management Behavioral (SFRM) Model," these types of human errors are grouped in the 4th Performance Element:

TEAMWORK	WORKLOAD MANAGEMENT
LEADERSHIP	**SITUATIONAL AWARENESS**
COMMUNICATION	DECISION MAKING

Effective forecasting of events and execution of tasks will be *based* on that perception. In other words, "Knowing what is going on around you." SA includes all the factors which could influence the successful completion of the task. It is clear that no single team member can have "Perfect SA," and that the degree of members' SA is affected by their access to information-often dictated by their roles. Good SA allows effective anticipation of critical events and planning. SA allows us to say, "It's on-track." Three key issues are involved in maintaining SA. These enable us to "Solve the right problem:"

- **Recognition of the critical elements of a situation**
- **Understanding the implication of those elements**
- **Projection of Consequences**

(…continued on page 4)

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It is clear that the first two bullets are all important:

People don't know what they know.

Traps: Finally, we must be alert to situations that are conducive to loss of the SA. Some of the more common traps:

- **Bored or busy with task**
- **Habitual tasks**
- **Expectations of outcomes/data/values**
- **Time-intensive tasks**
- ***Tasks familiar but not done recently***

CHECKLIST for Recovering Situational Awareness

Regardless of what feeling, clue or observation triggers our sense that our own or our team's SA has deteriorated, immediately take steps to recover:

Call "Time Out:" Identify the problem
(ID the *actual* problem to be resolved)

IF (When): the problem has been *correctly* identified THEN:

- **Gather information using all available, pertinent resources**
- **Determine possible Courses of Action**
- **Reach Team concurrence and select a Course of Action**
- **Write paper, obtain needed resources (people, tools, GSE, etc.)**
- **Conduct briefings, walk downs, etc.**
- **Implement Course of Action**
- **Monitor and evaluate results and make adjustments.**
- **Call "Time Out "again, if necessary.**

As always, CORRECT INFORMATION is the *only* arbitrator among possible courses of action or differing viewpoints.

George Sweeney is currently employed by United Space Alliance as the Lead Human Factors Specialist in USA Ground Support Systems Safety in both Industrial and Human Engineering. For 20 years he was an officer in the United States Marine Corps where he served in over 300 combat missions in Southeast Asia, flying the F-4 "Phantom" fighter. Ten years after returning from combat, he was named US Marine Corps Flight Officer of the Year in 1981, retiring later in 1986 as a Lieutenant Colonel. After his military career he put his degrees in Psychology and English, along with his extensive military training, to work in the civilian sector. Possessing superior knowledge in the areas of Aviation (both military and commercial), maintenance, human factors, training and education. Mr. Sweeney was a highly valuable employee and supervisor. Immediately after leaving the military, he joined Allen Corporation of America in Alexandria, VA where he was the Program Manager for the US Customs Airborne Sensor Operator Training Program. After staying with Allen for 3 years, Mr. Sweeney moved to Northwest Airlines in Minnesota where he was the manager for their General Pilot Training Programs and Flight Operations. In this position, Mr. Sweeney had significant contact with human factors, further enhancing his skill sets. Today, employed by the United Space Alliance, he is responsible for investigating mishaps and the training and standardization of other investigators/fact finders. Mr. Sweeney also passes his knowledge to the next generation by teaching classes in human factors, hazard recognition and error avoidance.

Ergonomic Interventions in a Library: An Evaluation Study

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Libraries have begun to automate and are facing ergonomic issues associated with the process. Libraries on Cornell campus and libraries nationwide are facing similar issues. The library is currently engaged in an effort to convert all card catalogues to computer catalogues. 25% of employees have undergone some form of treatment; more than70% of employees have had their workstations modified or replaced. Library work consists of different tasks and work processes other than "standard" office work. Currently no systematic process exits for determining needs and evaluating interventions.

Previous Research on Libraries

The issue of library ergonomics has been largely ignored. Research on library ergonomics has centered around library users. Studies addressing library employees have been limited in scope. No standards have been developed for the design of workspaces and purchasing of equipment. Here are a couple of examples of workstations at the Library:

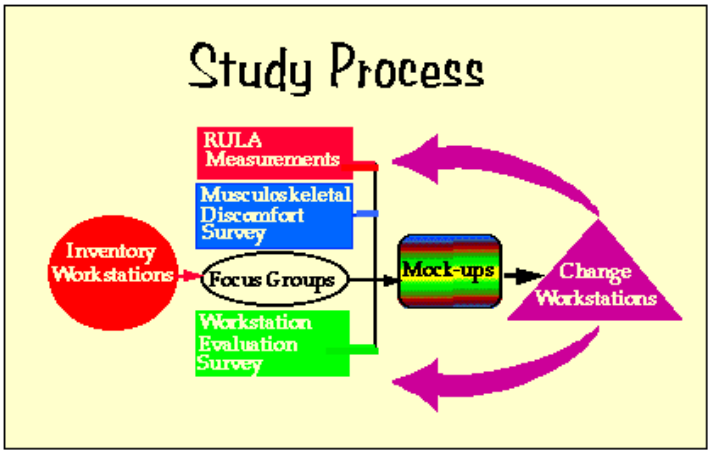
<—This picture is an example of a workstation, which is not well suited to computer work. Here an old typewriter stand is being used for a computer, providing no adjustability to the work surface. A lumbar support has been added to a chair, which meets almost none of the requirements for ergonomic design and the arrangement of the workstation, specifically the location of the two garbage pails leaves little legroom.

—->This picture when compared to the previous one is a good illustration of the variability in the workstations at the library. This is an example of a "newer" workstation. The piles of books and other materials on either side of the keyboard are a perfect illustration of one of the major concerns raised in the focus groups, namely the need for more surface area.

After doing an initial walkthrough and completing an inventory of the current workstations, a study process was developed. Four methods were chosen to evaluate the current situation:

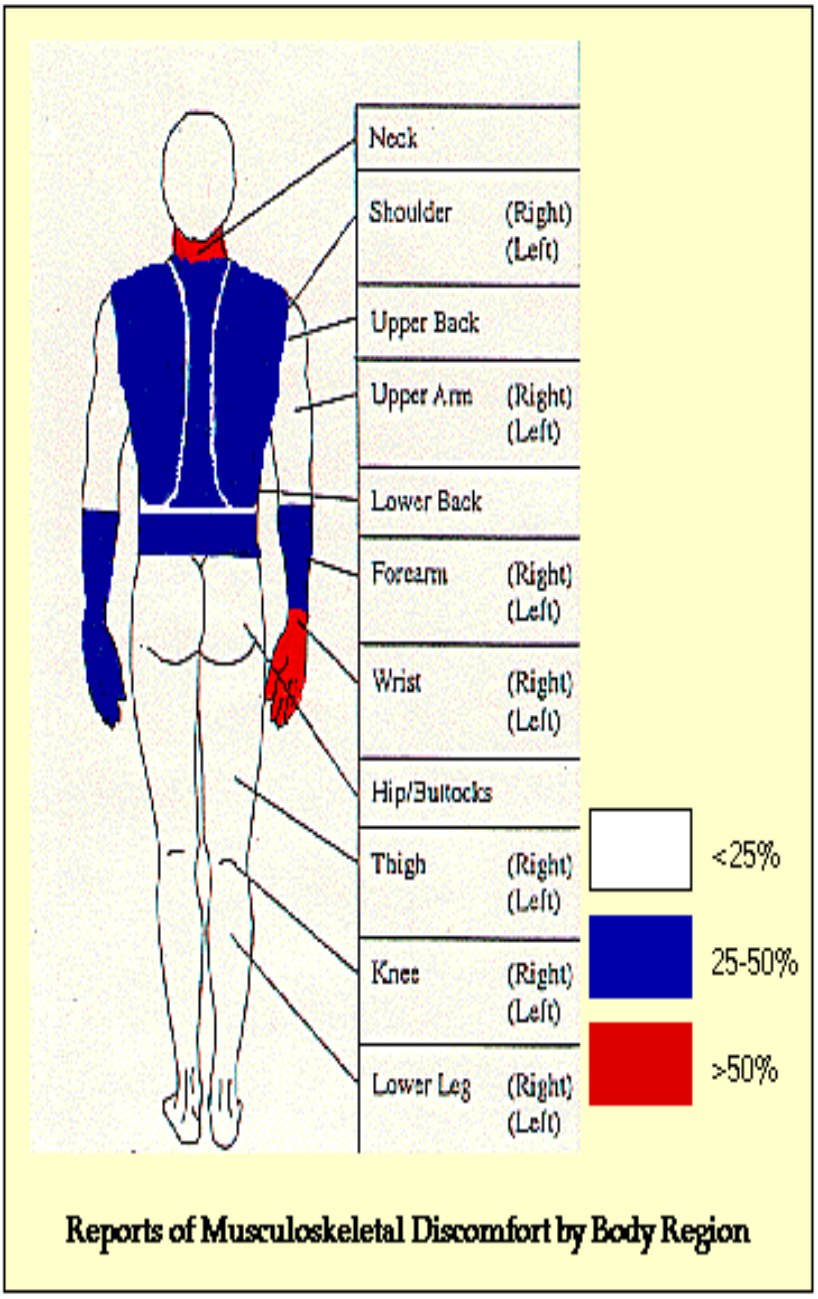
- Postural Analysis using RULA
- Musculoskeletal Discomfort Survey distributed to all employees asking them to indicate location and extent of discomfort.
- Workstation Evaluation Survey distributed to all employees asking them to evaluate elements of their current workstation
- Focus Groups with representatives of each task group in order to determine the design needs of each task group.

This diagram illustrates the study process:



After analyzing the data, an alternative workstation design will be developed and demonstrated to the library employees giving them an opportunity to try the workstation and provide feedback on its appropriateness. A portion of the workstations will then be changed to the new design and the change will be evaluated by again collecting data using the methods previously mentioned (not including focus groups).

The data from the self-report survey and the observational RULA measurement concur, indicating that the areas of greatest concern are the neck and wrist (ergo).



Reports of Musculoskeletal Discomfort by Body Region

(article continued from p.7)

Pre-Intervention Results

Musculoskeletal Discomfort Survey

The figure on the left illustrates the areas of discomfort reported by the library employees represented by % of reporters.

It is clear from these results that the areas for which discomfort was most commonly reported are the right wrist and the neck.

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Currently employed through United Space Alliance, LLC, in the GSS Safety/Industrial and Human Engineering Department at Kennedy Space Center. Liz received a B.S. in Computer/Information Science from Indiana University of Pennsylvania and an M.S. in Safety Science from Indiana University as well. Liz' areas of expertise include applied ergonomics, Human Factors in System Design, Psychology, risk management, accident investigation, system analysis and design, computer programming and occupational and environmental safety.

RULA Postural Analysis

RULA provides a score which is indicative of the extent to which a person is at risk for injury, the higher the score the greater the risk to the individual. The table below is a listing of the mean scores for all the subjects broken down into component parts. In this way it is possible to determine what parts of the body are contributing the most to the total score. The results indicate that it is the posture of the wrist and neck, which are putting subjects at the greatest risk for injury.

References

http://ergo.human.cornell.edu/ErgoPROJECTS/Library/library.html

Further details of the study and the proposed new workstation designs are available by visiting: http://ergo.human.cornell.edu/Library/library2.html

A useful resource on Library ergonomics: UT Austin General Libraries Ergonomics Task Force

RULA Assessment

	Upper Arm	Lower Arm	Wrist	Neck	Trunk	Leg	Final Score
MEAN	1.94	2.12	2.90	3.02	1.98	1.00	3.73

Note from the Space Coast Human Factors and Ergonomics Society acting President:

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Welcome to 2009 SCHFES! It's my pleasure to step in as acting the President due to the unfortunate relinquishing of the position by our former leader. We wish her well in all her endeavors!

Just a quick recap on 2008, as it was a very busy and productive year for our little chapter!

- We held a dinner meeting that was well received by the attendees, "Curing Space Sickness, Using Cancer Drugs, and the Vomit Rocket!?" By Dr. John French.
- The new website is up and running and we are looking for someone to take over as webmaster =).
- Last March we made a nice presence for both the HFES National Chapter and our Space Coast Chapter at the 2008 Applied Ergonomic Conference that was held in Orlando.
- In September we attended the 52nd HFES National Conference in New York.
- Dr. Debbie Carstens, Publications Director, and her Student Production Manager, Ms. Windy Thomas published the first volume of the new SCHFES Newsletter; which was packed full of enlightening articles by some of our terrific members!
- We began a process of updating our By-Laws to reflect minor changes in officer position job descriptions. We will be wrapping that up and sending it out for you to review and vote on sometime in late spring.
- At that time, we will also be holding regular elections so please consider volunteering your leadership talents to our organization. Whew, what a year!

For 2009 we are looking forward to more goodness such as:

- Learning and networking events, (e.g., one around the end of March: To-Be-Announced),
- The continued expansion of our website.
- An October event for National HFES month, also TBA.
- The 53rd HFES National Conference in San Antonio, TX, October.
- Further volumes of our newsletter will be released based on article submission; so please submit articles, suggestions, announcements and research results or any other valuable insight and information you would like to share. Send to Dr. Debbie Carstens, Publications Director at carstens@fit.edu or wthomas2008@fit.edu.

Finally, it's that time of year again when we will begin our ***membership drive***. You can fill-in the Membership Application at http://schfes.org/documents/SCHFES%20Membership%20Application.pdf. Please attach your check and send both along to Henry Riley, our Treasurer. If you know someone who might be interested in joining our group for networking, information, employment opportunities, fun, and more, please forward the application to them or point them to our website. The current board members are looking forward to serving you again this year, and we welcome any feedback or suggestions you may have. Cheers!