## Lessons Learned

02/11/2013

**Team Dynamics/Product Management**

- Order all components in single order to ensure matching of parts
- Order form reliable sources
- Order additional backups to ensure the meeting of deadlines in case parts become damaged or in operational
- Flexible scheduling necessary
- Maintain weekly communication with customer
- Maintain subfolders in SVN
- Following code of ethics a necessity
- Effective communication and active participation
- Specify customer needs t optimize time management
- Identify manufacturing resources/machinablity ahead of time
- Reuse original mechanical parts for sake of time
- Ensure parts used are well documented for troubleshooting
- Refer to professors on unfamiliar subjects

**Controls Improvements/Recommendations**

- Adding a CE to the group for system optimization (remote access)  the he
- Off the shelf control board easy to implement/ debug
- Replace serial cable with USB
- Board contacts not isolated
- Don’t place control board on metal surface
- Having initial code a benefit
- Improve cable from control board to microcontroller
- Implement limit switches

**Pump Assembly Improvements/Recommendations**

- Benefit to have multiple motors to test
- Size motor to maintain resolution, but improve speed
- Implement large factor of safety for motor torque
- Flexible couplers expensive, but a benefit
- Lead on lead screw properly sized
- Track sliders an improvement on friction

**Manipulator Assembly Improvements/Recommendations**

- Lower friction bearing sliders a benefit even at extra cost

- Size and weight of cylinders a determent to specifications
- Lowering spring constant
- Develop solid mounting system to ensure axial direction

**Hydraulics Assembly Improvements/Recommendations**

- Smaller cylinders/less volume of water
- Further research diaphragm cylinders
- Decreasing cylinder length/length of line
- Implement spring to prevent lines from crimping
- Double compression fittings worked well
- Increase length of valve support bracket

**Manufacturing/Assembly Lessons Learned**

- Double check measurements of bulk material
- Hard to ensure perpendicularity and parallelism due to threaded fastener tolerances
- Create single piece for all three axes versus individual axis (bearing blocks, motor mounts)
- Single pinned connections prone to pivoting
- Secondary horizontal bar on lead screw carrier unnecessary
- Machining from bulk material saves time versus reusing parts