Rehabilitation Engineering Center

INTERDISCIPLINARY COLLABORATION BETWEEN
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
DOCTOR OF PHYSICAL THERAPY STUDENTS
& UNDERGRADUATE ENGINEERING STUDENTS AT
NORTH CAROLINA STATE UNIVERSITY

This presentation will cover…

- Interdisciplinary education
- Definition of rehabilitation research
- UNC-NCSU Rehabilitation Engineering Center, and:
  - How to get started
  - Role of a PT student
  - Project timeline
  - Additional opportunities
- First REC project: Developing a portable transfer board

What is interprofessional education?

- Some problems cannot be solved within a single profession—they require other areas of expertise[2]
- The essence of IPE is students learning with, from, and about each other in interdependent groups[1]
- The process of becoming a professional is being socialized into the patterns of thinking and behaving required by your profession—IPE provides different, valuable viewpoints as you work with those in other professions[1]
- IPE increases your personal insight, understanding, and skill[1]

What is rehabilitation research?

- Research committed to the theme of "human function and rehabilitation" is based on the ICF model[4]
- The aim of this research is to minimize the experience of disability not just in individuals, but within groups and populations[4]
- Rehabilitation research is uniquely positioned to integrate and translate the advances of sciences into benefits for people[4]
  - Engineering focuses on optimizing a person's capacity
  - PT focuses on enabling the person in their immediate environment to achieve optimal performance

How can we make this successful?

- Collaborations are more effective when team members communicate about[2]:
  - Motivations for the project
  - Beliefs about science
  - Definitions of appropriate data
  - Accepted research methodology
- Friendship and solidarity among team members is important for success[2]
- Engage in projects that have real-world application[3]
- Reflect as a group throughout the process to enhance efficiency and minimize conflict[1]

What is the Rehabilitation Engineering Center?

- History
  - Initiative of the College of Engineering at NCSU and the School of Medicine at UNC, formed in 2011
  - A state technical assistance, education and research center that evaluates, designs, innovates, and promotes improved care and function for individuals with short and long term rehabilitation needs

- Mission
  - Improve quality of life, personal and work environments, and products through careful study, analysis, research, design and education of students and people with special needs.

What does the REC do?

- By combining the medical strengths of UNC and the engineering aptitude of NCSU, the REC serves to:
  - Cultivate, coordinate, and stimulate design projects between UNC and NCSU
  - Integrate the expertise of two disparate fields of medicine—science and engineering
  - Cultivate innovative research between UNC and NCSU
  - Function as a clearing house for questions/problems concerning special physical needs with rehabilitation
  - Assist the state by stimulating technology transfer and economic development in a growing area within the field of biotechnology

What does the REC do?

- The REC stimulates, coordinates, and financially supports start-up collaborations, special projects, seminars, symposia, and research and education concerning rehabilitation

- Co-Interim Directors
  - Dr. Rick Segal at UNC
  - Dr. Richard Wysk at NCSU

Who will you be working with?

- The REC facilitates rehabilitation engineering design projects through existing engineering courses
  - NCSU College of Engineering
    - Visit the NCSU College of Engineering website to find out about the various disciplines that you could work with
    - http://www.engr.ncsu.edu/departments/
  - Additional opportunities
    - Work with Duke biomedical engineering students in the fall semester: http://bme260.pratt.duke.edu/
    - Work with UNC biomedical engineering students in the spring semester: http://www.bme.unc.edu/~rlg/rehabDesign/

What are the differences between programs?

- In collaborations with NC State, products are typically developed for a larger population
  - A general need has been identified in a group of people, and a product that could be widely manufactured is designed and developed
- Projects at Duke and UNC are generally patient-specific
  - A need has been identified for a person within the Durham-Chapel Hill community, and a semester is spent designing that person a customized product

What will you be doing?

- PT students serve to put engineering students in contact with a patient or a patient need
- You have the clinical knowledge and patient access that the engineering students do not, while they have the design and engineering education that we lack
- The job of the PT student is to present a researched idea that is a definite need, and provide consultation and design input as the engineers design the product

How do I get started?

- Determine a need
  - Is it something for a specific patient?
  - Is it something for a group of patients?
  - Is it something that could be improved in the clinic?
- Think about discussions with PTs, patients, other students, and clinical experiences you have had
- You can work with a classmate together on a project- is there anyone in your class with similar interests who may know about a need?

What do I do if I don't have an idea?

- Don't worry! Our faculty and other therapists know patients with specific needs
- There are many existing ideas that could benefit someone, they just need specific attention and your skill set
- If you have a particular patient interest, contact a professor with a similar focus, or a CI in a similar setting

So you've got your idea!

- Market research
  - Does this product or something similar currently exist?
  - If so, how much does it cost?
  - Is it manufactured by multiple companies?
  - Is it widely available?
- Determine that this product is worth producing
  - It will benefit others
  - It is an improvement to existing technology
  - It is a novel idea that has not yet been developed

How can I find out more information?

- Visit the REC website at http://rec.bme.unc.edu/
- Get in touch with Lisa Johnston at UNC
  - lisa_johnston@med.unc.edu
  - 919-843-5723

What can you expect as a participant in the REC?

- You (DPT student(s)) will be working in conjunction with 1-3 undergraduate engineering students on their senior design projects
- Weekly meetings (in person or teleconferencing) with director and team as project progresses
- Frequent communication with your team
- Consulting faculty, clinical instructors, peers for input as design progresses

Project timeline

- Formulate idea and get in touch with appropriate people during **fall semester**
- Submit a proposal abstract to be distributed to senior engineering students
  - Brief outline of idea, purpose, patient population, and desired outcome
  - This allows the engineering students to select a senior design project that interests them

Project timeline

- Initial meeting with team will be during January of **spring semester**
- Be very clear about your idea and your thoughts about its implementation
- Come prepared and ready to answer questions about its use, availability, and be able to defend the need for it

Project timeline

- You are going to be only person providing the clinical and medical perspective
  - Engineering brains and PT brains work very differently
  - Don't be afraid to voice your opinions or concerns—they are relying on your knowledge and patient experience to formulate the best possible product
  - Many great ideas happen as a result of these different viewpoints coming together and collaborating

Project timeline

- Table of requirements (**late January**)
  - Table of all possible options for the product
  - Utilize this to narrow down to specific design parameters
- Brainstorming (**early February**)
  - Once idea has been derived from table of requirements, group can brainstorm about potential designs, features, design attributes, materials, etc
  - Collect the results from the brainstorming and group similar ideas together
- Select 1-3 options and determine specifications (**mid-February**)
  - Each engineering student can begin thinking about one option
  - PT student will provide input about item feasibility and requirements

Project timeline

- Pre-prototype (**late February**)
  - Miniature or non-functional prototypes developed as a starting point
  - A physical example of an idea
- Failure mode and effects analysis (FMEA) (**early March**)
  - Engineering students find out product limits and consider all potential modes of failure
- Prototyping and failure testing (**mid March**)
  - Build actual prototype and test it to failure
  - Multiple prototypes will likely be developed

Project timeline

- Product development (**late March**)
  - Incorporate results of prototype testing to develop product
- Producibility (**late March**)
  - Throughout process, consider producibility of the product as you decide on final materials and development process
  - Could this easily be replicated?
  - If it is a device for general use vs specific to one patient, is it something that a manufacturer would feasibly develop?
- Final product and poster (**April**)
  - Produce final, functional product
  - Produce any required posters or write-ups
  - Present at REC symposium

Additional Opportunities with the REC

- Potential to develop poster for presentation at Rehabilitation Engineering Symposium held in April
  - Poster fair for people involved with the REC
  - Includes faculty who have received grants, other undergraduate students
- Potential to present at APTA's Combined Sections Meeting
  - Submission deadline for abstracts is in early April—consider this as development progresses
  - Submission deadline for posters in late May

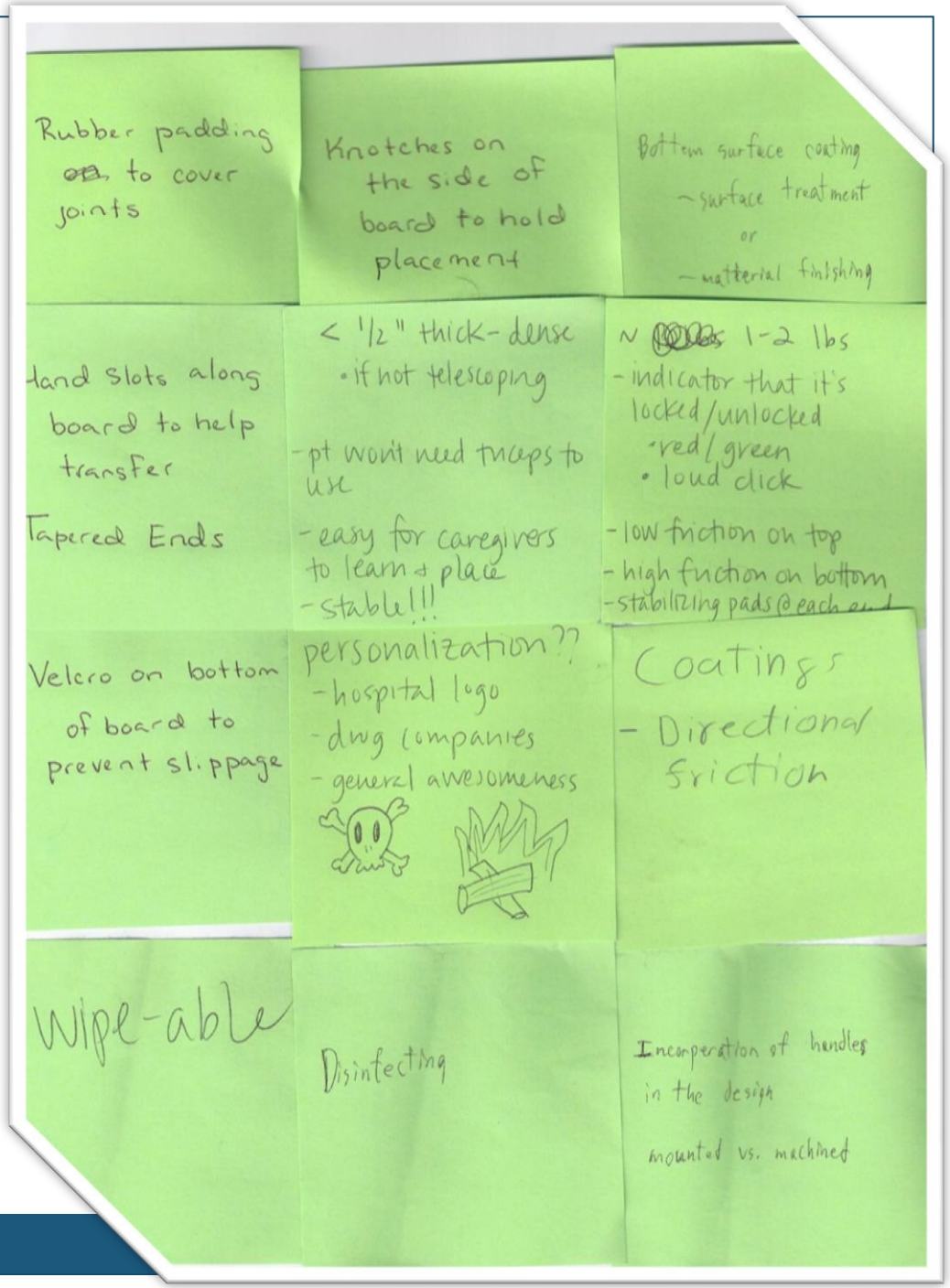
Personal experiences with the REC

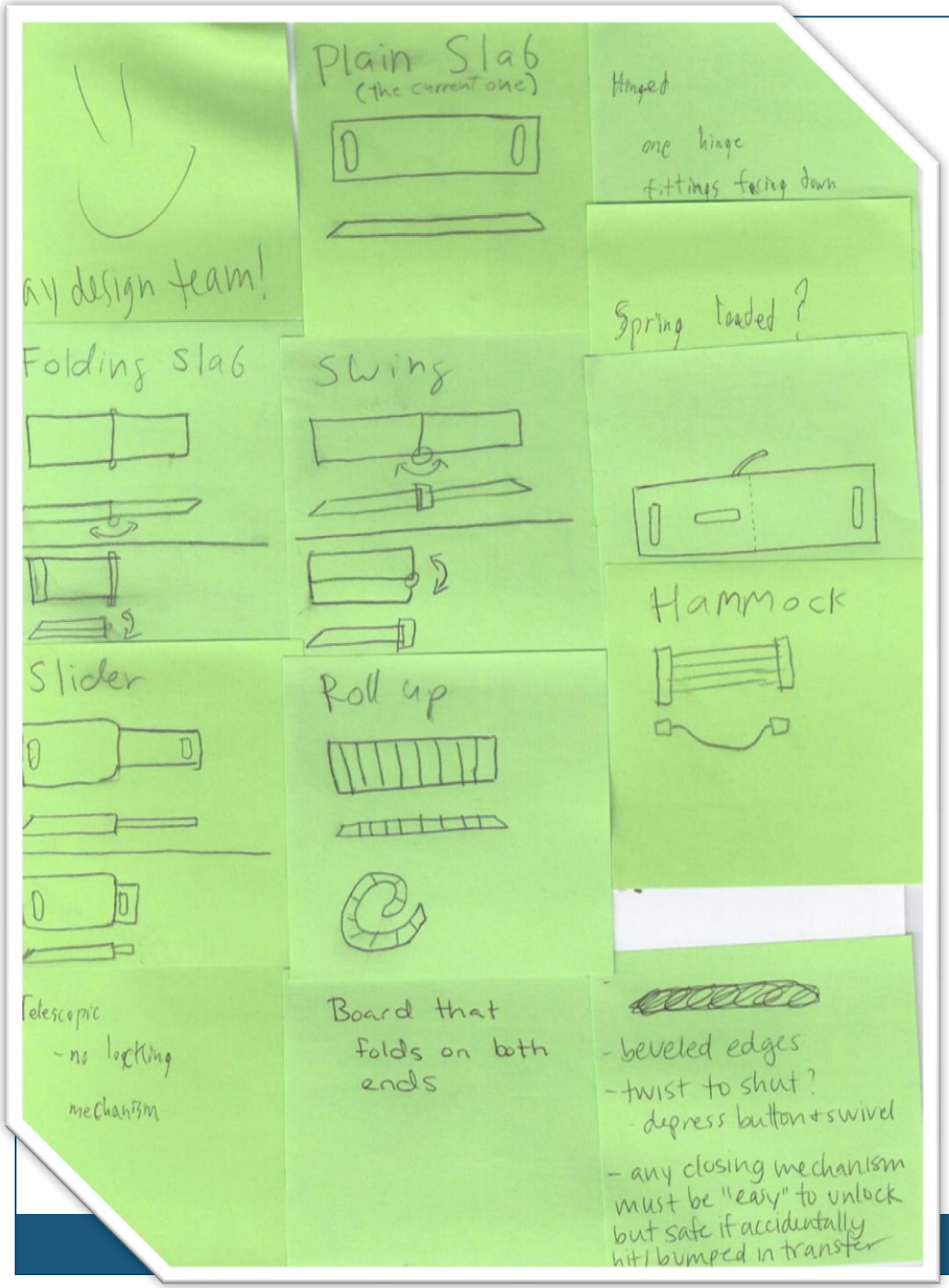
- First project through REC was development of a portable/collapsible transfer board
- Idea came on 3rd clinical working in inpatient rehabilitation with SCI patients
- Current boards large and cumbersome, heavy, difficult for patients with limited motor function to place and transport

Personal experiences with the REC

- Initiated contact with UNC at start of 3rd year, discussions with Dr. Wysk at NC State during 3rd year fall semester
- Submitted proposal abstract in December of fall semester, which Dr. Wysk presented to students in the Industrial and Systems Engineering (ISE) program
- 3 students chose to participate in the REC to produce their senior design project

Brainstorming the device features



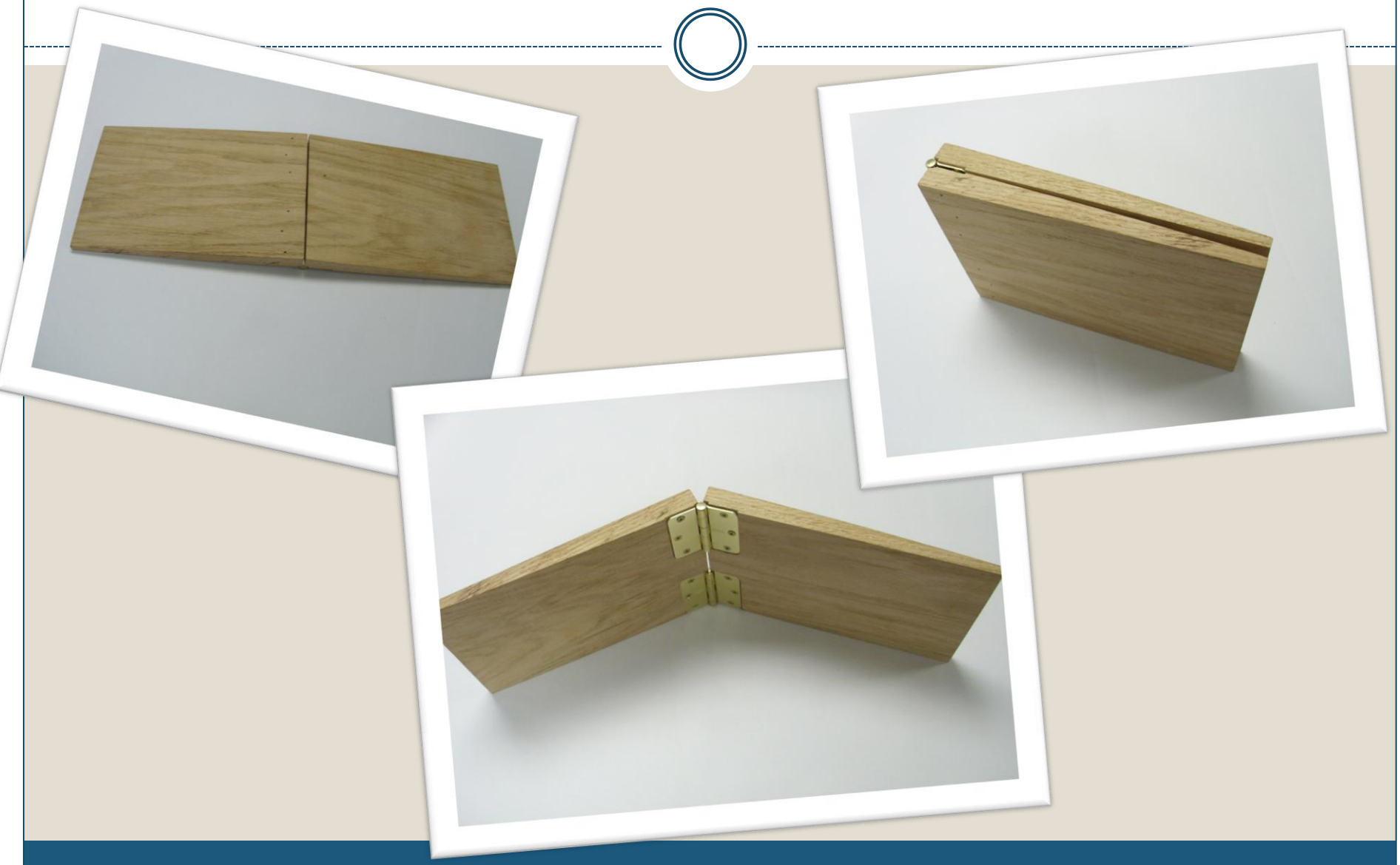


Brainstorming optional designs

What did we decide?

- Design a carbon-fiber version of the traditional board
- Develop a collapsible board using one of the following design options
  - Hinge
  - Telescoping
  - Roll-up

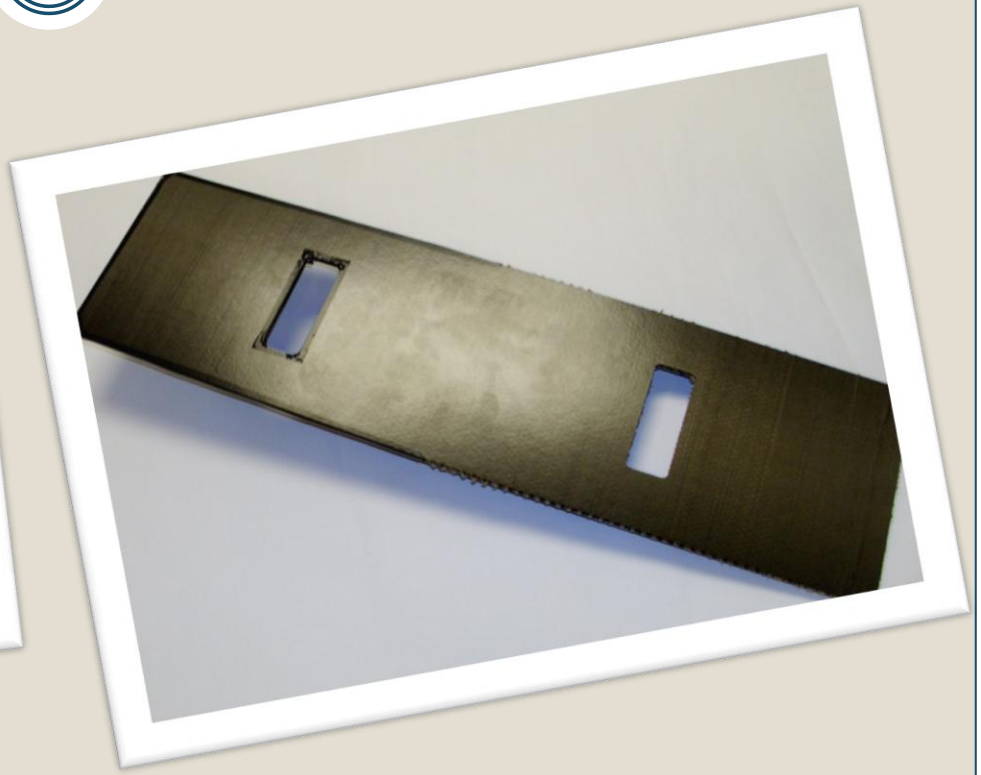
Hinge prototype



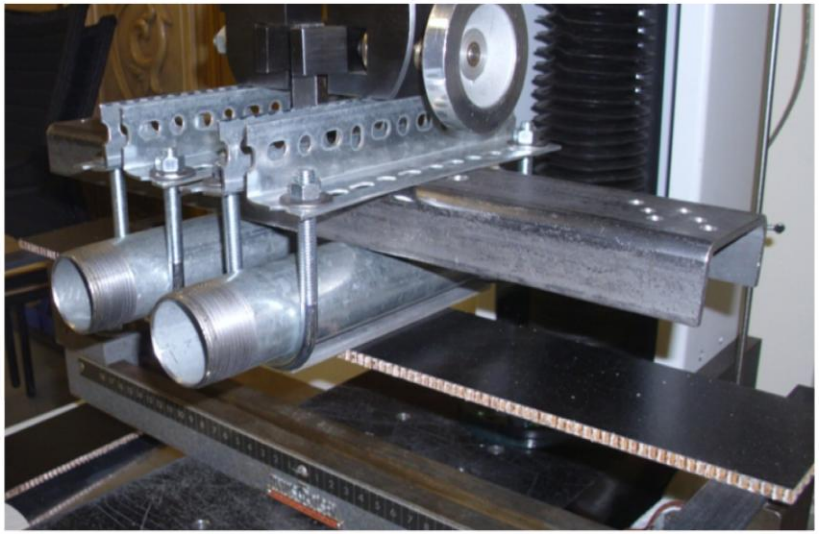
Telescoping prototype

Roll-up prototype

Carbon fiber prototypes



Failure testing of prototypes



Final products

Final carbon fiber board

Final hinged board

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