The Art of Building a Presentation Prototype

By: Ron Williams

Please allow me to introduce myself to you. I'm Ron Williams, a Product Developer currently employed at the General Motors Design Center in Warren, Michigan, assigned to the Apex (Advanced Portfolio Exploration) Design Studio as a lead sculptor.

The type of projects we work on are in the advanced product discovery area of new automotive architectures. These in turn are used to illustrate a designer's brand character, or the GM corporate brand images.

The following presentation is a project that catalyzed a new product development revolution in wheelchair designs. The Untied Nations declared 1981 as the International Year of the Physically Challenged, and it was at that time I was inspired to start this project.

Vision

Vision: *Taking a rough idea through development, to the presentation prototype.*

I'm just like every one that boots up this web site at modelmakers.org, having aspirations of some day being a builder of great professional looking models and prototypes, or being a contributor in the process of developing product ideas, or in some cases, of your own inspirations. This is an opportunity for me to share with you some of my tips and tricks.

In this HOW-TO presentation I use traditional low-tech hands-on product development methods to design, engineer, model and fabricate this product idea to a high quality presentation prototype, step by step.

It's the dawn of a new era in the field of aids for the Physically Challenged.

Innovative engineering integrity combined with aesthetically comfortable design

Engineering and Styling: Tailored for People

Influenced by a highly admired and collectable lounge chair designed in 1929, the Barcelona was designed by Ludwig Miles van der Rohe, and manufactured by Knoll International. His side profile was a key graphic element, and my starting point for this design. The attached narrative takes you from my product Vision, to the presentation prototype of the ELEGANT WHEELCHAIR.

Elements of this product mission included having compliance with EMS vehicles, designing the wheelchair to be Rapid Transport Ready, and becoming a proactive partner in saving lives.

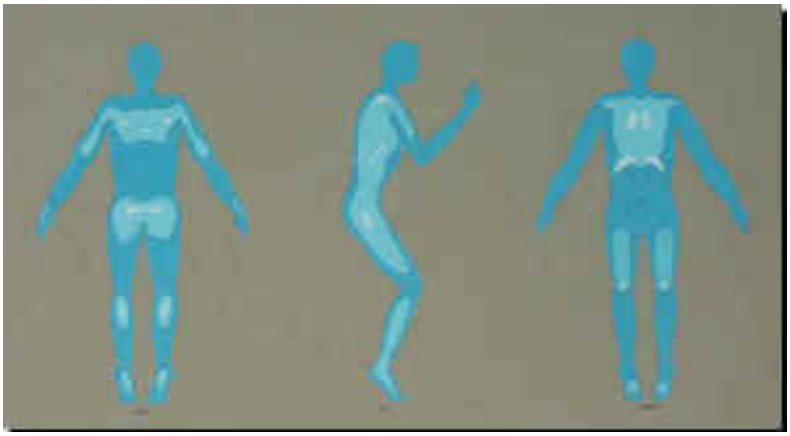
Current wheelchair designs are a symbol of negative healing stigmas. Enabling people to heal faster is part of the goal. By de-stigmatizing wheelchair designs, I believe this will contribute and enable a more positive healing experience for the people confined to them.

The wheelchair also serves as a Temporary Gurney Unit, delivering the patient to the Operating Room. It can also be used in the field as a portable Trauma Station.

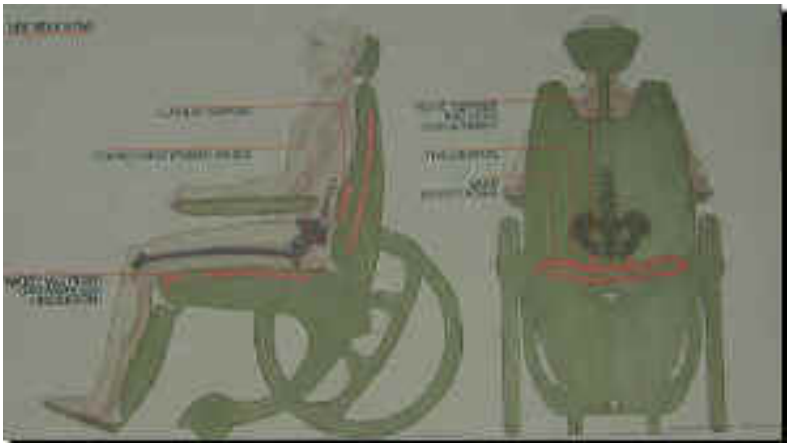
Design

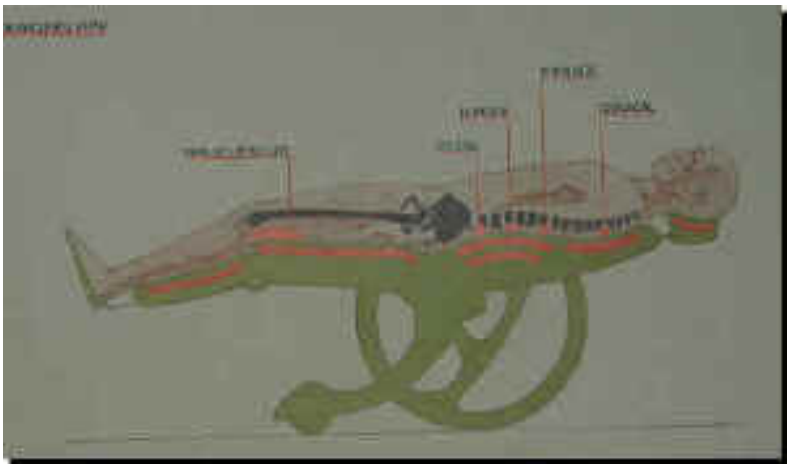
Design: *Anatomies and Ergonomics as they relate to this product.*

The Human Factor - One major problem: Decubitus ulcers. Caused by poor circulation and the continuous touching of body parts to seating contact zones.



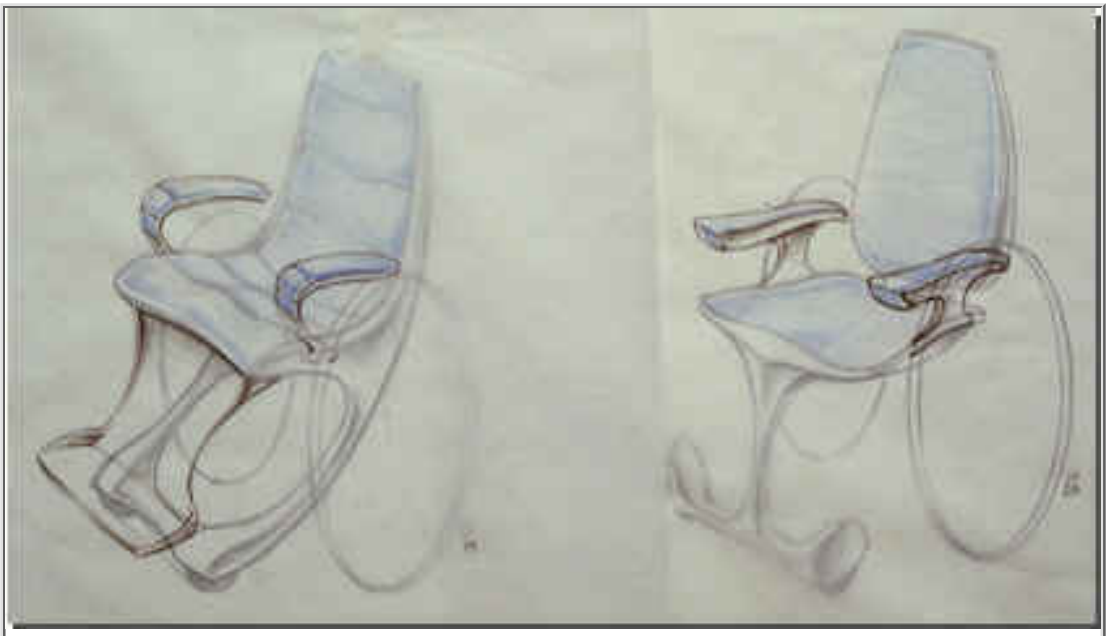
Solution: To create a starting point of human factored individually customized seating architectures.





During brainstorming sessions, work with a wish list of requirements. Quick sketches of your ideas can **produce fast visual concept discoveries**. Post them up so you and others can view them continuously. Have other professionals scrutinize your ideas, grow a thicker skin, get them on your excitement plan or whatever it takes to have a competitive edge. If you can't sketch your ideas, record your thoughts and

recruit a student designer from a local design school. Be creative, **having the ability to illustrate your ideas is paramount**.



Great design forms, product functions, and a wish list of user needs define the product shapes.

Intelligence drives the styling, consumer functions, composite materials and the optimum manufacturing process. Allied with the human factor, provide the starting points for designing parts and component drawing. Do continuous reconnaissance of product competition; know what options they offer and cost, springboard, and reinvent. Use this information on your product strategy board. Display product styling ideas, colors and textures you like, the hippest product trends, and pin them up. Study and learn from them. This will provide you with your design instruction intelligence.

Packaging of user options: Know the product footprint in relationship to user/consumer needs and the environments of the product operation.

· Armrest adjusts and retracts in to seat base, allowing for side exiting of the occupant.

· Wheel fenders, a removable option

· Adjustable calf and foot support

· Spoke-less wheel

· Planetary adjustment knobs

· Product motion envelopes

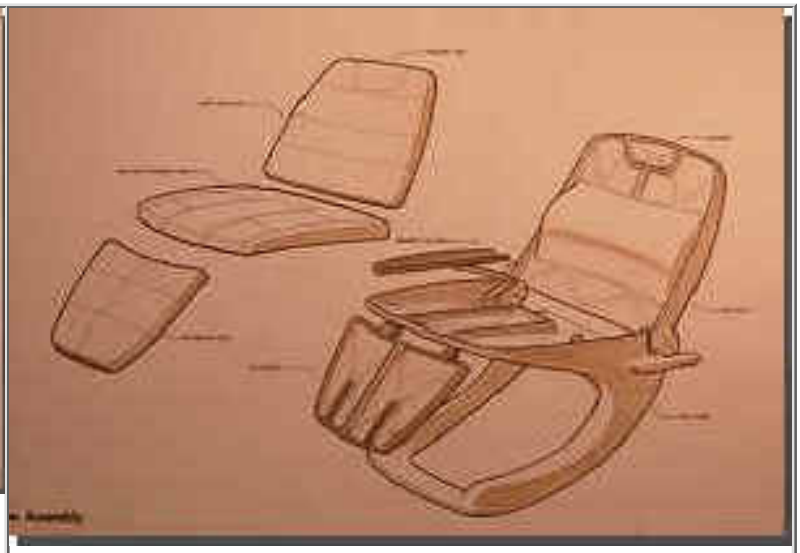
· Seatback reclines; wheelchair becomes a day bed or a transport gurney

· Adjustable wheelbase compensates for changing center of gravity and allows occupant side exiting and best and gripping advantages.

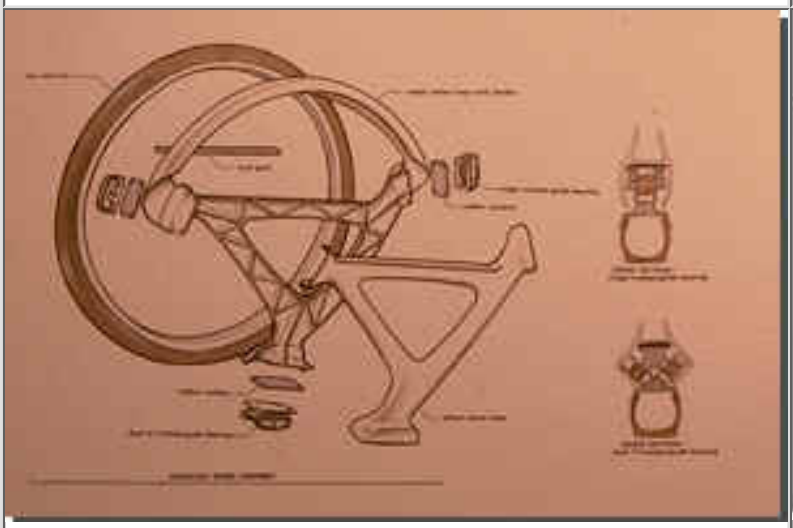
Design (continued)

Game plan: Your design should display the optimum number of prototype parts that concisely demonstrates your concept to your target audience. Brainstorm with other professionals to reverse engineer your part designs, realizing new design improvements. Get to know the Thomas Register at your local library, a great resource guide. Become a kindred spirit and form product development alliances with your vendors and design associates.

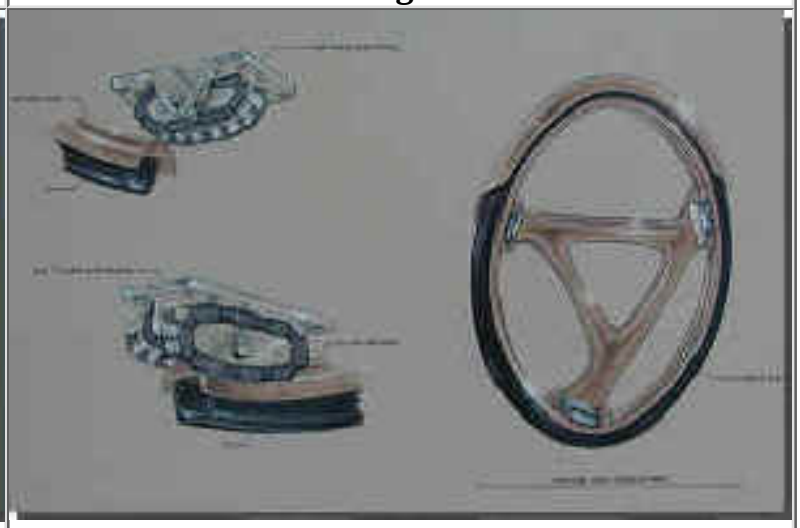
Monocoque composite prototype parts designs



Custom seating architectures



Spoke-less wheel assembly



3 Point wheel bearing system

This is the full size tape drawing/rendering that I used to create my working drawing:

Armatures

Clay modeling armature: The foundation for creating a great model is good planning, of modeling functional constraints. Think far enough ahead. Actually think about how and what kind of mold and part design and materials you plan to use so you don’t have to stop and redo or change your setup later. Here is the model armature for the monocoque (frame) seating structure.

Removable seat armature with grid surface place

Profiled modeling platform

Seat armature stanchion with profiled modeling platform installed

Fabrication of the bottom companion to seat model armature

Clay Modeling

Master right side, and the making of a cardboard template

Marking a locating line for the template

Transferring template to the left side location and creating the new section

Filling between tempered sections and finishing the model surface between the sections. Repeat process until left side is reproduced from the right side of the master model.

Clay Modeling (continued)

Surfacing and adding details to the clay model. A good model armature design will allow total access to all areas to be modeled for detailing and checking alignments to other design components. Later during the mold construction phase, the model armature provides great tooling alignment aids for the precise assembly of the mold components for the assembly of the monocoque seat structure and FRP (fiber reinforced plastic) part components.

Clay model becomes removable by detaching it from its seat armature stanchion

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Checking alignments of the wheelchair seating structure model to water closet/toilet and spoke-less wheel mock-up for fit and design proportions.

	The floor heights were setup higher to accommodate for detailing the clay model surface. Companion stanchion adds stability when the profile modeling platform is removed.

Hand rim gripping model process: Adding an aluminum drag section plate to the holding fixture with a polished edge gives you high quality finish area on the model surface.

Clay Modeling (continued)

Spoke-less wheel model supporting structure with removable fender option attached for display purposes:

Model is thicker, allowing the integrated removable fender option included into one model design. 1/8" thick masonite profile is used as contact area base plate for modeling of the spoke-less wheel design.

Adding runoff to model provides easy access for hand laying up of FRP part (Fiber Reinforced Plastic)

Hand grip, calf, and foot supporting accessory parts / clay models

Plaster modeling substrate / Hand grips modeled on seat-back plaster substrate

Foot support is inserted, adjusted, and mechanically fastened in this area of the calf supporting portion.

Modeling and Molds Comments

· The clay modeling medium is a Chavant product #307 which is a wonderful modeling material to work with for rapidly developing your ideas in to a 3D form. The material provides the ability to make changes on the fly and surface finishing to a hi-gloss for check your model highlights. In the credits, I have supplied the websites for purchasing modeling materials, tools, and where to purchase how-to clay modeling and molds construction videos, from basic to advanced modeling skills.

· The clay models are prepared for the mold making process. Build up was added around the circumferences of the model, approximately two inches high, and the clay surface sprayed with a release agent. In This application a strippable vinyl material that creates an adhesion barrier was used, allowing for clean separation of the plaster molds from the clay model surface. Note: If the clay surface is un-protected the clay will bond to the plaster material and mold separation can be difficult and clean-up very time consuming. (A mixture of grease and mineral spirits can also be used by brushing it on and wiping off the excess with a clean cotton cloth, or a product called Part-lub D9 can be sprayed on and air dried.)

· You should apply two surface coats of plaster mold material. Using Ultra-Cal 30 , the plaster should be mixed to a thick but creamy mud with no lumps. It is best to sift the material into the water container until the plaster is completely absorbed by the water. When the plaster is completely saturated, you can start mixing the plaster and water solution to a thick but creamy mud with no lumps. It should be just thick enough for pencil to stand up vertically with out falling down. You might vary this mixture to suit . This mixture is brushed or poured from the center out, taking care to remove air bubbles and lumps. It’s a pretty forgiving material to work with.

· The two surface coats of plaster material is applied to the model surface. The first surface coat hardens about 75% to the touch, promoting good adhesion of the 2nd surface coat . This 2nd surface coat prevents the hemp and plaster solution from disturbing your finished mold surface. The third coat approximately one inch thick plaster reinforced and totaled saturated is now applied for strength. Note: hemp is formed in to small nest shapes, for easy of handling

· The addition of a base adds strength and tooling utility options to your mold design.

Plaster Molds

Spoke-less wheel covers, hand grips, and calf supports

Plaster Mold system: The mold assembly was designed in the beginning while designing the clay modeling armatures. The mold alignment base was reproduced from the profile modeling platform, becoming the foundation alignment tooling aid. This allows the seating structure mold components to fit precisely together during the laminating and bonding process of the indivisible prototype parts used to fabricate one unitized wheelchair structural part, forming the backbone of the prototype monocoque wheelchair frame.

	
Mold alignment base: Allows for the precise alignments of all mold components	**Inner left mold component, nesting on alignment base**

Left and right, inner and outer mold components, with center key section removed. The key section permits the inner mold components to be removed during the de-molding of the final assembled part

The key section secured into location

Mold matrix assembly process: After all the FRP parts are hand laminated and trimmed (while remaining in it's individual mold component) these parts are bonded together to form a component group. Then these are assembled onto the mold alignment base.

The mold matrix is bonded together temporarily, using bandage size plaster soaked hemp swatches to hold the mold together during the curing of attachment joints of the FRP part encased in the mold matrix. This acts like a cocoon and is very strong, effective and easy to remove, for de-molding the enclosed monocoque composite part.

Plaster Mold Comments

· The molds were constructed of a US Gypsum product called Ultra-Cal 30. The number 30 represents minutes, the time to set. Molds usually can be pulled in 45 minutes to one hour depending on the ambient temperature, or when the plaster mold starts sweating. Sweating is caused by the exothermic heat reaction, the water added catalyzed the plaster in turn, heat is generated and cooks the water out causing sweating.

This is very fast and inexpensive way to produce a temporary mold. Note: prepare the mold making area by laying down a layer of tarpaper/craft paper, to catch and manage the mess.

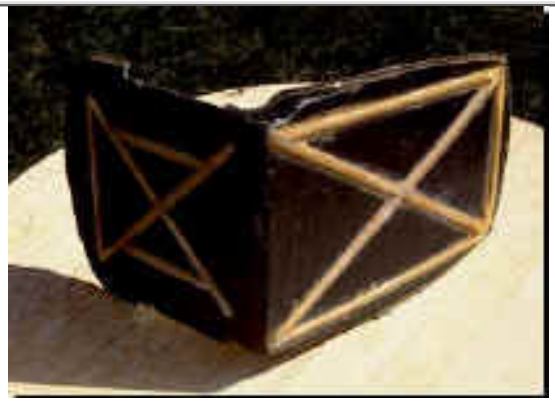
· The molds are designed to be expendable , because this prototype is a one of one. Additional parts can be made using these materials and process, but in very limited quantities.

· After all expendable molds / tooling are constructed, the plaster molds are dried in a oven overnight, eliminating moisture, providing good adhesion for sealing with orange shellac . The surface is now sealed, waxed, polished and brushed or sprayed with a release agent. The polyester FRP parts were hand-laminated to a thickness of 3/16 of a inch.

Preparing parts for final assembly

Seating cushion carrier insert: Shown with ridged urethane foam cushions

Seating cushion carrier insert with six mounting attachment points



Constructed of carbon graphite with laminated balsa stiffeners

The seating carrier insert is a holding fixture, keeping the seating cushion in design aliment with the wheelchair mounting attachment points

Rigid urethane seating cushions

Fabrication and installation of attachment hardware: Assembly of parts into sub assembles, checking for problems, fitting and parting alignments

Adjustable attachment point

Bonded-in attachment brackets for arm rest and calf support mounting points

Assembled spoke-less wheel

Adjustable armrest linkage, seating carrier insert, and adjustable pylon mount

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Post Assembly

With the completion of composite and metal fabricated parts, the seat cushions now can be aligned to the monocoque chassis and fitted for material clearances for final upholstery. The attachment and mechanical hardware is fine- tuned and mounting brackets bonded in to place. The wheelchair prototype can now be disassembled for further detailing.

A scale comparison of the wheelchair to a human form

Post and Final Assembly Comments

· After all parts are de-molded and trimmed to size, cleaned and inspected for imperfections and the flaws fixed as required. The wheelchair is assembled for a first-time look to evaluating the prototype in its untried form.

· This is when most design problems are discovered, so make your design refinements as required. Example: changing of materials and or the adjustments of ergonomic features etc. Document the problems and make the improvement later. If you're a solo product developer working alone, brainstorm by using a voice activated tape-recorder while mocking up rough model ideas, play it back and listen to your thoughts.

· The prototyping process drives the overall innovation process, each prototype becoming better, evolving the design to its' optimum product solution. Make extra parts and send them out to vendors and acquire cost quotes and/or design improvements. If you get stuck, hire a mentor / consultant to answer tough questions and bounce off ideas. Prepare a laundry list of questions you want to cover in advance to expediting your objectives. Information is king, so keep everyone on your team up-to-date.

· Fast, rough models and mockups give you cheap quick 3D solution. Learn to work with Styrofoam, Gator and Foam Core materials. Which produce a fast 3D model before committing to a more costly modeling process. Digitally photograph this information and e-mail your team members and get additional opinions before committing to the new design.

· Only after you are satisfied with the post prototype results of fit and finish, (specifically the FRP parts) mechanical performances of hardware and over-all design aesthetics, then you are ready to disassemble the prototype for final detailing.

· Final detailing and paint. Check all sculptured propositions, surface highlights and make sure all character lines are sharply balanced and well defined. This is one of the most important and time consuming steps. Its' the editing and fine-tuning of the products styling vocabulary. Your personal

signature, communicating the product idea to your viewer, expressing the Brand Character images of your vision.

· You only get one chance when presenting the final idea to your target audience. So do your homework, its all in that last 2% everyone talks about, paying attention to the details.

· This article is brief in most areas, my purpose is to Introduce myself to you and give you a sampling of what you can do with a low-tech, hands-on approach to mode building and product development. I will publish additional how-to articles on a variety of subjects from time to time. Until then I hope I have provided you with helpful information for your design and model construction needs.

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In April 1991, Metropolis Magazine sponsored a design competition called "2001: How Will We Live?". In July 1991, I received a letter from Metropolis Magazine stating that my design was chosen to be in the "Design Explorations: 2001 Exhibition" at the International Contemporary Furniture Fair at Jacob Javits Center in New York City.

At the Design Museum, London, England, the Elegant Wheelchair was selected to be on display in the Review Gallery from 1991 through 1993. The Review Gallery at the Design Museum shows new products, concepts and prototypes from around the world. The focus is upon contemporary and future developments in design, and provides an unparalleled opportunity for visitors in London, England to see the most important and up-to-the-minute examples of international design.

This is what the Future can be, but that's another story...

Credits, Resources, and Closing Thoughts

Closing Comments

I hope you have enjoyed this information and it whets your imagination and gives you some good ideas to go out and design and build your models better, faster and less expensively. This is a very effective low-tech / low-dollar method to build models and prototypes of your product ideas, the trade off is time-to-market. Springboard off this information and make it better, plan, be resourceful, focus and have fun. If you have any comments you may email me at ronhwilliams@mediaone.net

Look for my How-To, Hands-on, articles on Product Development from time-to-time, at my website now under construction. Articles on: Furniture, Toys, Bicycle, Fashion, Machine tool and Automotive specialty products

Special Thanks To:

- The Association of Professional Model Makers, APMM for allowing this article to be viewed at their website.
- Knoll International - The Barcelona lounge chair photo.

The Team:

- Tim Weeks - Industrial Designer - enormous creative talents, with special efforts in making this project happen.
- Patrick Pigott - Illustrator extraordinaire - uncanny ability to understand my visions and put them into a visual media.

- Tom Thews - Illustrator and gifted artist - the Metropolis Magazine, design competition 2001 entry illustration.
- Ray Haves - Brilliant technical and manufacturing mentor.
- Alexis Kokinakis - Flawless upholstery.
- Carl Blankenburg Sr. - CEO, AMP - Injection molding manufacturing, production guidance and part and unit costing.
- Ralph Nichols - President, Dale Carnegie courses, Inspiring professional coach and friend.
- Bill Miron - Miron Holding Co. Sage - Business model.

Resources:

- Cerritos College - Terry Price - Director of Composite Education, The California Technology Hub. tprice@cerritos.edu
- Chavant - Clay modeling materials, tools and Instructional videos, how-to clay modeling volumes 1&2. Mold making and FRP preparation volumes 3, videos created by: Stephen Stringer for Chavant, a must have for any modeler. www.chavant.com
- Serious Play - Book by: Michael Schrage, A great read, on what's happening now in product development. at Borders Books.
- Models & Prototypes - Book by: Shimizu, Kojima, Tano, Matsuda - Models in Clay, Plaster, Styrofoam, Paper. A how-to short story. Borders Books.
- Time Compression Magazine - Article May 2001, " Is Model Making a Lost Art or a Growth Industry" By: John Connolly. www.timecompression.com
- The Thomas Register - Products & Services, Company Profiles, Search by Brand Name, Company Catalogs. www.thomaspublishing.com
- The Promise of Play - IDEO - part 1 video, The Mothers of invention, Direct Cinema Limited 310.636.8200
- The Salesman of the Century - Ron Popiel , Inventing , Marketing and Selling on TV. Tapes at www.amazon.com
- Return On Innovation -Book by: Bill Dresselhaus, A four-star process resource guide . Only at his website www.BillDresselhaus.com.
- Russ Simpson Co. - Ultra-Cal plaster products and model making supplies. 586.771.2768

Want to learn more about this wheelchair design? Check out my patent at you local library. USA Patent Number 4,593,929