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# Approaches to Developing Creative Future Mobility Solutions by Applying Inclusive Design Strategies

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## Abstract
By 2030, urban areas will be the home for more than sixty percent of the world's eight billion people. This will create tremendous pressures on megacities as the current infrastructure is repaired and expanded, which will introduce the need for new mobility options. This paper focuses on a collaborative studio at the University of Cincinnati that developed new mobility devices as solutions to these future challenges. Inclusive Design strategies were integrated into the design process so mobility devices would appeal to a broad segment of urban populations. Best collaborative practices are elaborated upon and three case studies are presented that were a direct result from this student project.

## Keywords
Urban, Transportation, Population, Inclusive Design, Collaborative, Interdisciplinary, Mobility, Systems Thinking, Systems Integration, Jigsaw Classroom Technique

## Introduction: Global Challenges
Personal mobility is likely to change in the future, especially within the urbanized world. These changes are most likely to occur due to expected increases of urban density that will cause stresses on megacities as they expand. This topic of urban growth is elaborated upon in *Reinventing the Automobile, Personal Urban Mobility for the 21st Century* by Mitchell, Borroni-Bird, and Burns when they state, *"The United Nations projects that 60% of the world's population will be living in urban areas by 2030."* Predictions for the world population in 2030 are estimated to be eight billion people. This will create tremendous pressures in the form of pollution, energy security and consumption, congestion, and traffic safety. This will also challenge public infrastructures that are already struggling to meet the growing demands for transportation and basic

mobility services. To accommodate the expected increase in urban density, plans should be considered now, including investing wisely in basic core infrastructure needs. These megacities will be so dense that the place for the traditional car will rapidly decline. Plans for the future must address the development of new mobility options.

With population increases, climate change, and the depletion of natural resources, industries are currently seeking solutions to these global challenges by considering alternative modes of mobility. In *The Dynamics of Global Urban Expansion* Angel, Sheppard, and Civco discuss the forces that will influence urban expansion. *"Aspects of the transport system that affect urban expansion may include the introduction of new transport technologies…"* Transportation costs, the amount of government investment in roads, and reliable public transport systems are aspects expected to act as catalysts to the introduction of new mobility options.

## Project Guidelines

In response to these predictions of increased urban density and the growing stresses this will have on the existing infrastructure General Motors (GM) developed a concept brief, which challenged students in design and engineering to generate ideas for a Portable Assisted Mobility Device (PAMD). This brief was created through collaborative efforts with Partners for the Advancement Collaborative Engineering Education (PACE), a group formed by General Motors to help facilitate interactions between industry and academia. PACE strives to educate and inspire students about the necessities of global collaboration and to foster awareness of current social and economic pressures. In keeping with this mission PACE invited selected academic design and engineering institutions to participate in this challenge. The University of Cincinnati accepted this invitation and in the fall semester of 2012 students from Industrial Design, Graphic Communication, and Mechanical Engineering focused on this project. The context of this paper elaborates on the results generated by junior students in design.

The PAMD project was defined as a small power-assisted vehicle that could be taken on a train, bus, or could be stowed or carried indoors. It addresses the first and the last mile scenario as it mixes seamlessly with public transportation and personal urban transportation. The PAMD was considered to be similar to a light eco car, a portable vehicle, a folding bicycle, or modular scooter. Enclosed design solutions were optional for concepts that include weather protection considerations. The PAMD concepts were to be designed to carry one passenger and their personal cargo, which could include a briefcase, purse, backpack, and other such personal items.

Each concept was to be buildable and theoretically produced for mass-production within 2-3 years. It was, of course, also important to consider sustainability. Each student or student team was expected to conduct research and design a product that was the solution for transportation needs as the population grows. Students were challenged to understand the social, economic, and convenience issues for their proposed mobility solutions.

One of the challenges in developing new mobility solutions is to understand individual needs of 1) those who drive cars, 2) those who do not drive cars, and 3) those who only use public transport for part of their mobility needs. In conducting this research several gaps were identified when observing how different mobility systems converge. Benchmarking research revealed existing products that potentially address the first and last mile scenario, however for this project new and unpredictable solutions were expected. This project explored problem solving in functionality and aesthetics while addressing realistic constraints. Students were required to develop concepts that were usable, desirable, and viable for the broadest market.

## Collaboration

This collaborative studio, as mentioned above, involved managing teams that included Industrial Designers, Graphic Communication Designers, and Mechanical Engineers. To manage these teams, a cooperative learning technique was used to organize classroom activities and encourage positive interdependence among team members. There are several different cooperative learning models that could be used in this setting such as Think Pair Share, Reciprocal Teaching, and Round Robin. An approach that is commonly used in design studios is STAD (Student Teams Achievement Divisions). This process involves evaluating all individuals equally based on their team's performance. For a good team this model can work well when all of the teammates encourage each other to perform at their best. However, the STAD model can also generate resentment and inefficiency if a teammate does not show the initiative or the level of productivity that is expected by the group.

For this project the collaborative studio was structured after Eliot Aronson's *Jigsaw Classroom Technique.* This cooperative learning approach involved training group members separately in their area of expertise so each member returned and shared their unique knowledge with teammates. For example, the Industrial Design students attended classes and lectures in their classroom and then shared their knowledge with their Engineering and Graphics counterparts. The Engineering and Graphics students followed the same model and also attended separate classes. The benefit with this model is that it encourages listening and engagement with individual group members who have learned unique material that is essential for group success. This process also created an efficient group learning method that increased the variety of learning experiences and design solutions available in the studio setting. The jigsaw method also enabled individual members to attend classes simultaneously instead of teaching all of the students sequentially. As a result, the instructors were able to use extra class time for group discussions and collaborative meetings.

## Inclusive Design and Systems Integration

When developing solutions to these challenges, integrating Inclusive Design into the product development process led to the discovery of innovative concepts accessible to a broad range of people. For this collaborative studio, the goal was to design a product that functions within an existing public transportation system and was usable to urban demographic groups. Each team analyzed the public transportation behaviors of various urban environments and then identified the challenges and gaps within those systems. They also assessed how multiple variables can influence one another within the entire system. For example, students were encouraged to ask who uses public transportation, why they use it, where they go, how it impacts their life, and how it integrates with other aspects of their life. Their goal was to understand how public transportation is a single component of many interrelated systems that affect a person's daily life.

This research phase in the project involved a combination of different approaches, which included sending out surveys, interviewing people, walking through and evaluating locations when possible, and studying relevant articles on community and regional planning. When the teams completed their assessment, each group developed personas of different user types, attitudes, and behaviors for specific demographic groups that represent the broader community. These personas proved to be a useful guide for the students when they considered how product features addressed the goals, desires, or limitations various groups face when using public transportation. This approach helped students focus on innovative functional features for the user and in the process of doing this they developed attributes that were not only attractive to the personas they developed, but also improved the product overall by making it more appealing and user friendly to a larger market.

Because student concepts were expected to integrate with public transportation, Systems Thinking and Systems Integration methodologies where introduced into the design process. This was essential in developing concepts that identified products and needs that would not ordinarily be addressed by large automotive corporations or urban planners, since they typically work separately, not collaboratively. The Systems Integration approaches were achieved with two distinct strategies. First, concepts that students developed, such as a bike cargo carrier, moped, or personal mobility device (as in the three case studies below), were to be integrated with public transportation systems. This integration was achieved through research in public transportation behaviors and urban environment analysis. This lead to direct applications of function or logistical aspects of making the blending of these two systems work seamlessly together. The second strategy connected the user with the product. This was achieved through the development of such things as motion graphics, websites, and applications, which clearly introduced these new products and their intended use to the customer. The use of these graphic visuals made each product easy to use and understand. Being user friendly would make these products more appealing to the larger community within the urban environment.

## Three Case Studies

Included below are three concepts offered as case studies that were a direct result of the collaboration. Each case study approaches the aspect of Inclusive Design and Systems Integration to develop alternative modes of mobility as solutions to the mounting challenges relating to transportation and urban growth. The design process involved an iterative cycle through four phases: research, exploration, creation, and evaluation. While working through this cycle, the groups worked hard to obtain information about the needs of the user, how to meet these needs, and how to design concepts that addressed these needs.

While these student examples are clearly academic in nature, they are presented as evidence for the serious validity of Inclusive Design in the creative problem solving process for future design challenges in academia and industry. Inclusive Design approaches were considered with the following case studies especially for the development of specific design features. These attributes are qualities that make each product more appealing to a wide range of urban dwellers. With each example, global challenges were addressed within specific urban environments, offering local solutions to designated areas. Each student team presented their concepts in a comprehensive process book, which details each phase of the design process in great depth. For the context of this paper only a brief description is provided for each concept that includes key information on the design features developed for a broader appeal.

### Cargo

Industrial Designer Leon Wenning and Graphic Designers Kevin Danielson and Lindsey Melling developed this first case study. They conducted research to obtain a better understanding of biking in an urban setting. From this data they discovered bicyclists could not easily transport several bags of groceries or other cargo from small shopping trips on their bicycle, a city bus, or a subway system. Research proved this to be a dominant challenge for riders that depend on public transportation systems and their bicycle. The design team decided to focus on this issue by exploring shopping trends and existing parking stations for grocery carts. They noticed that a typical shopper often picked up last minute items that were not pre-planned. This activity can be difficult for a bicyclist who does not have the extra space to carry these items.

After analyzing this data, the design team began researching existing products. They noticed that bike trailers address some of the issues raised in the surveys, but they did not provide any assistance when pulling heavy loads. Trailers also did not adapt easily to different shopping environments. As a result, the team developed a motorized bike trailer called *Cargo* that can convert into a shopping cart. (Figure 1) This product was designed specifically to help people move their belongings from point A to B without the use of a car. This design allows people to load their items in the store and immediately attach the cart to their bike outside the store. The process of loading and unloading items from a shopping cart to a bike trailer was eliminated with this design. The motor also provides assistance when pulling heavy loads. This allows a casual bike rider to use this design without worrying about strain or fatigue. A digital rental system outside grocery stores was also developed to provide access for users who cannot afford or do not want to purchase this device. (Figure 2) The goal was to provide immediate assistance to last minute purchasers who need help transporting their goods. This concept can potentially be introduced locally or globally as it could be adapted within any urban setting and appeal to a very broad market.

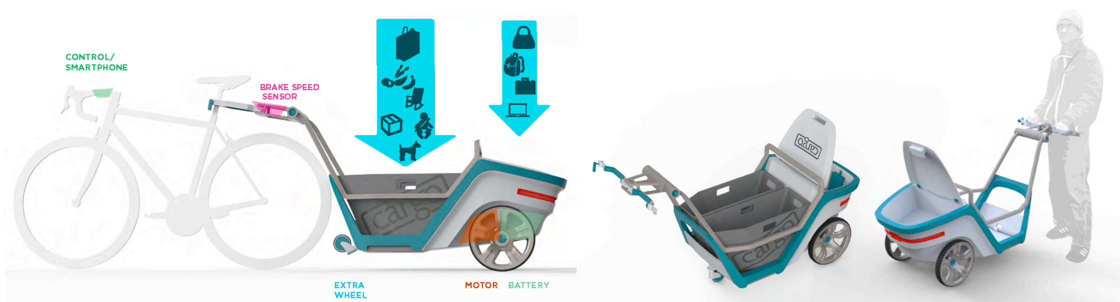


Figure 1: The *Cargo* has an electric motor to assist in making the experience of transporting goods less problematic. In addition to converting to a shopping cart to be used in the grocery store this bike trailer was designed to be reconfigurable in order to carry many different types of objects.


Figure 2: The *Cargo* concept integrates with a digital rental system outside Whole Foods and other grocery stores so bicyclists can easily have access to these trailers in places where they are most likely to be needed. Easy access to this product would increase usership.

## Ciclo Nova

*Ciclo Nova* was a concept developed by Industrial Designer Miranda Steinhauser and Graphic Designers Brock Arthur and Kate Menkhaus. This design addresses issues related to urban transportation in South America. This design team researched various articles as well as community and regional planning publications for Rio de Janeiro. From this research they noticed that in the last decade, the number of cars in Rio de Janeiro has grown forty percent. As a result, traffic congestion has become an increasing problem. To address this issue, Rio has developed over 180 miles of bicycle paths that crisscross the city. This design was based solely on research articles and online surveys with individuals who live in that area. From this data they found that the public would like to have a device that could travel longer distances and would give them the option to commute a portion of their journey with existing public transit systems. Using this data, the design team decided to develop a product that can be used on existing bicycle paths, travel longer distances, and does not contribute to the air pollution that can exist in highly congested areas. The final design was a battery powered moped, which according to their research could legally travel on Rio's existing bike paths. (Figure 3) This moped is smaller than a traditional motorcycle making it ideal for these bike paths. Charging stations were designed to allow individuals to lock up and recharge their moped when they use public transit systems. The team also designed a mobile phone application that allows individuals to map out traffic patterns, existing charging stations, and transit lines. (Figure 4) This feature was developed to seamlessly integrate this design with Rio's existing transit system.

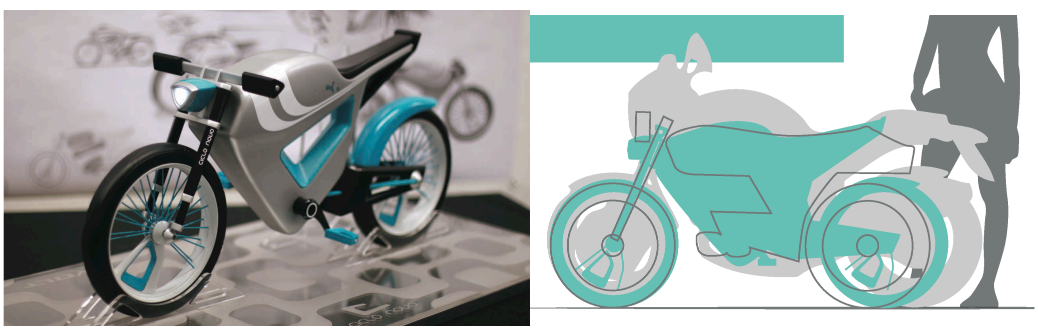

Figure 3: The final model for the *Ciclo Nova* concept was built in Autodesk Alias and 3D printed as a 1/3 scale model. A package comparison on the right shows the *Ciclo Nova* concept as being smaller in size compared to a traditional motorcycle.

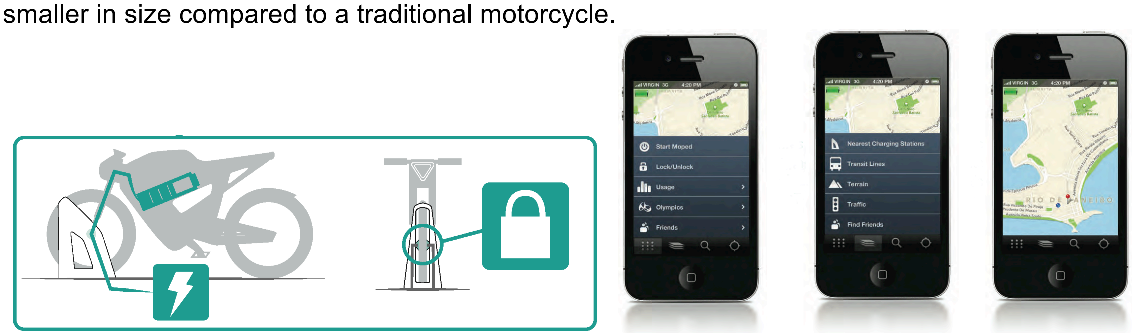


Figure 4: Charging stations allow individuals to lock up and recharge their moped when they use public transit systems. Mobile phone applications were designed to allow riders to map out traffic patterns, existing charging stations, and transit lines.

## GoSozo

Industrial Designer Heesung Jang and Graphic Designers Chad Ackerman and Tony Pierce designed the *GoSozo* concept. This is a device that addresses current urban transportation issues in one of the largest cities in the world: Tokyo, Japan. This design team researched various articles as well as community and regional planning publications. From this research they noticed that the challenges Tokyo faces for urban transportation are similar to other urban areas around the world. Traffic congestion, parking difficulties, longer commuting times, and loss of public space must be considered for this environment. They also noticed that electric bike sales in Asia Pacific are projected to grow rapidly over the next five years. This group was not able to research Tokyo's environment first hand, however they used projected sales trends and an online survey to guide their design decisions. The survey helped provide additional information on individuals who live in congested areas in Tokyo. It revealed that people wanted a product that is easy to use, energy efficient and affordable. The device would also need to easily navigate congested areas and it would need to be portable so people could store it in a small space. After assessing all of this data, the design team researched existing and potential products that could meet these needs. They found that many options where difficult for most people to use (skateboard, rollerblades) or they appeared unstable and dangerous (Segway, motorcycles). As a result, the team developed a sturdy three-wheeled platform which users stand on while holding onto handles. (Figure 5) To make the design unique, the team developed a series of highly colorful graphics that allows individuals to customize the final look of the product. The small size of this battery-powered device allows commuters to easily navigate busy streets and sidewalks. The platform also folds up so the device can be pulled when the rider would like to use the public transportation system. This also makes the device very compact and easy to store when not in use. (Figure 6)

Figure 5: The final design of the *GoSozo* concept with personalized graphics. To the right is the GoSozo concept compared with a Segway. The occupant is lower when compared to the occupant on the Segway, which lowers the center of gravity making the device safer to use.

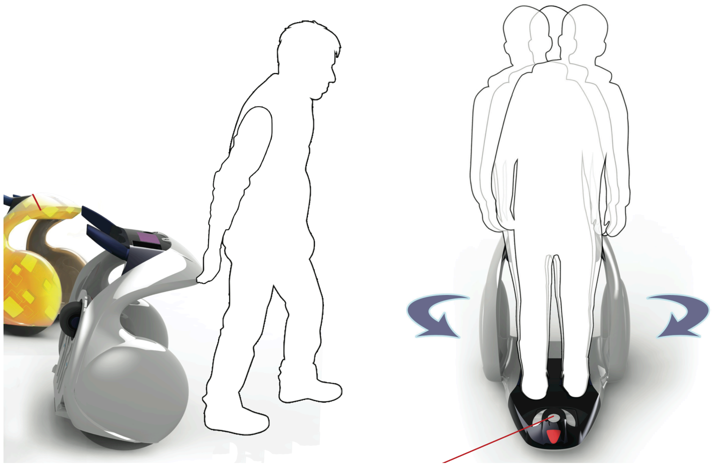

Figure 6: These images show the GoSozo platform in two different states. Folded up for portability and folded down when in use. The rear part of the GoSozo platform can be folded up so the device can be pulled. This makes it easy to take onto trains, buses, and other public transportation systems.

Overall this project provided an excellent teaching opportunity. Prior to this experience, several Graphic Design students never worked on a project related to mass transportation and mobility. Many students also had never worked in a collaborative studio setting with individuals from various design and engineering disciplines. From this experience, the students learned how to research and analyze complex problems and apply their knowledge as a team to manage and design potential solutions. Each group focused on very different issues regarding urban transportation. Their methodology to address these problems was similar, but their final outcomes were quite different. Incorporating aspects of Inclusive Design helped students appeal to appropriate users within the urban environment. Unique features developed for each concept made them easier to use and desirable to the broadest market possible within the urban setting. Adding Systems Integration into various phases of the design process assisted in identifying unexpected opportunities and in helping the customer understand the product and their intended use.

Within the studio setting 14 different PAMD concepts were developed, including the three case studies presented in this paper. The final designs received positive feedback from representatives from General Motors, the City of Cincinnati, Queen City Bike, and Mobo Bicycle Coop. Students and faculty were encouraged to pursue this collaborative project further. In the future we plan to narrow the geographic scope of the project to allow the students the opportunity to physically visit and analyze the environment they plan to design for. We would also like to include more individuals from community and regional planning to incorporate their knowledge of urban infrastructures and transportation alternatives.

## Conclusion

Within the industry, automotive designers typically focus only on the production vehicle they are assigned to work on and do not consider aspects of the environment that their products will operate within. Of course new experimental vehicle types and technologies are developed within advanced automotive studios and we see evidence of this with concepts created by General Motors, including the 1996 EV1 (Electric Vehicle Generation 1), the 2002 Autonomy Skateboard Platform, the 2009 PUMA (Personal

Urban Mobility and Accessibility Project), and the 2011 EN-V concepts (Electric Networked-Vehicle). It is worth noting that the PUMA and EN-V concepts address the urban domain but will never make it to production. Only now are we seeing hints of these advanced technologies in production with the 2011 Chevrolet Volt. The numerous reasons why these products are slow to penetrate the mainstream market go beyond the scope of this paper, but within the context of Inclusive Design this topic is worth consideration.

Innovative and alternative ways of getting around are needed for conserving an ecological balance. We are at a pivotal time when pollution, global warming, and the depletion of specific natural resources are current global challenges. In the future the anticipation of population growth and urban density will make these matters worse if we do not develop new habits. Innovative technologies and mobility products can influence and change the behavior patterns of large segments of the population. As these new products are put into production and introduced to the market early adaptors are likely to be the first users. Getting these products into the mainstream market could prove to be a daunting task. However, incorporating Inclusive Design and Systems Integration into the automotive production design process could manifest into a significant shift in developing products that are better suited for the environment and successful within local and global mainstream markets.

## References

**Angel, S, Sheppard, S, and Civco, D** (2005). The Dynamics of Global Urban Expansion, Transport and Urban Development Department, The World Bank Washington D.C.

**Aronson, E. and Patnoe, S** (2011) Cooperation in the Classroom: The Jigsaw Method, 3rd Edition, Martins the Printers, Berwick upon Tweed

**Gharajedahi, J** (2006) Systems Thinking, Managing Chaos and Complexity, A Platform for Designing Architecture, Second Edition, Elsevier Inc.

**Mitchell, W, Borroni-Bird, C and Burns, L** (2010) Reinventing the Automobile, Personal Urban Mobility for the 21st Century, Massachusetts, MIT Press

## Required Reading for the Project

**Duhigg, C** (2012) The Power of Habit: Why We Do What We Do in Life and Business, Random House

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