Home Innovation
RESEARCH LABS™

ASSISTIVE MULTI-FUNCTIONAL CABINET UNITS

Prepared For

U.S. DEPARTMENT OF VETERANS AFFAIRS

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EXECUTIVE SUMMARY

The "Assistive Multi-Functional Cabinet Unit"[1] project undertaken by Home Innovation Research Labs was funded by the U.S. Department of Veterans Affairs (VA), through its Specially Adapted Housing Assistive Technology (SAHAT) Grant Program. The research was conducted in support of developing new assistive technologies within the residential environment. Assistive technology is defined by the VA as "… an advancement that could aid or enhance the ability of a Veteran or Servicemember to live in an adapted home."[2] The specific goal of this research is to provide innovation to Veterans and Servicemembers in need of minor mobility support that can be quickly and easily incorporated into their residences, thereby extending an impaired individual's independence. While this technology was developed for the VA, its benefit can be extended to other groups who experience minor mobility impairments, as well. This research does not address accessibility concerns related to major mobility issues that require full-time use of large assistive devices, such as wheelchairs. Major accessibility issues are addressed through other VA Programs.

Home Innovation's designs for the "Assistive Multi-Functional Cabinet Unit" project address a gap in the market for those consumers whose physical capabilities fall somewhere between that of fully independent and wheelchair confined. This technology provides an effective, ergonomic, low-cost, and attractive modular cabinet solution that not only offers standard storage and work surface features, but also adds important new functionalities to assist those with a minor degree of impairment extend their independence in the home environment. This concept was designed to complement the existing space within a residential kitchen or bath by adding a self-contained "work-station" cabinet unit. This cabinet unit offers adequate space to consolidate tools needed to perform daily tasks and maximizes the work surface area to facilitate performance of those tasks. This cabinet unit can also be customized to meet specific end-user requirements for height and length.[3] Customization can be further accomplished through the addition of after-market accessories, such as hardware and lighting features. This cabinet unit offers an affordable, quick-delivery design that can be installed easily in either a stand-alone or series configuration in (or near) the kitchen or bath areas as needed to meet the accommodation requirements of the end user.

Home Innovation has worked extensively with subject matter experts to develop the design of this cabinetry, and has provided building schematics for four different units. These cabinet units require construction, delivery, and installation by a qualified manufacturer. Since the units are not available in retail stores, consumers will need to partner with a cabinet maker to purchase the unit(s) of their choosing. Mass production of cabinets typically requires an order of approximately 15 cabinets of a single design. While mass production would allow consumers the quickest delivery option and a potential price break, the customizable nature inherent in these assistive cabinet units may render mass production a non-viable option. To facilitate production, consumers can present the plans provided within this report and on the Home Innovation website to any qualified cabinet maker for immediate manufacture. The anticipated build time for each cabinet unit is approximately 3-5 days.[4]

[1] https://www.benefits.va.gov/HOMELOANS/sahat_awards.asp
[2] https://www.federalgrants.com/Specially-Adapted-Housing-Assistive-Technology-Grant-Program-69340.html
[3] Standard depth to remain unchanged to adequately accommodate aftermarket accessory features
[4] Manufacture time and cost of the unit(s) will vary depending on level of consumer customization and/or manufacturer-specific constraints.

BACKGROUND

There is a wide range of need among impaired individuals who require mobility assistance and accommodation. The degree of assistance required is largely determined by the nature of the specific condition and its subsequent effect on the individual's daily tasking.

For many Veterans, age or injury has resulted in reduced vision, reach, stability, stamina, tactile strength, and flexibility. The subject group for this project is characterized by being able to perform most of the tasks they have traditionally done in their homes, but may now require additional time, or are in need of an easier method, to perform those tasks. Members of this group do not require use of wheelchairs or significant supervisory care from others, but the onset of minor changes to physical health has forced the need for mobility accommodations within their daily residential routines.

Many of the daily tasks we conduct within our residences center around kitchen and bath areas, and a major component inherent to those areas is the cabinetry. The use of cabinetry to accommodate physical needs within a residence is not new, however, many of the solutions offered for impaired individuals focus solely on meeting ADA standards for major assistive device users, such as those confined to wheelchairs. Wheelchair accommodation is characterized by a need for lowered counter heights, wider aisleways, low-profile hardware, rounded corners, and shorter reaching distances. These adjustments require significant changes to standard counter configurations and may in turn hinder those with lessor mobility impairments, such as those who use canes, walkers, or crutches, as well as individuals with balance issues.[5] The ADA-focused solutions also tend to require permanent alteration to the home, dictating a complete retrofit of living space to accommodate the dimensional and functional issues related to wheelchair use. This approach is costly for the consumer and requires a significant investment of time to design and install. For this project's target group, who are not bound by wheelchair use but still struggle with traditional tasking in the kitchen and bath (i.e., reaching down or up to access the contents within standard cabinets), a more immediate and less-invasive solution is needed to accommodate their mobility issues.

OBJECTIVES

With this need identified, Home Innovation convened a Technical Advisory Group to identify and develop the requirements, as well as desirable features, for assistive cabinetry that would help those who need minor accommodation to remain independent. Subject matter experts (SME) in the therapy industry were contacted and formed a consultative focus group to discuss the challenges within the target user group. The Technical Advisory Group suggested a product concept designed for users with limited income and limited space, that could be put to immediate use upon delivery. The team took into consideration the physical needs of the target population as they discussed daily routines such as reading the mail, plugging in/charging a phone, watching television, fixing/eating meals, writing, etc.

The SME Group quickly identified efficiency as its primary objective for the design. Cabinets had to be ergonomically designed to provide a better working environment for the target group to allow daily tasks to be completed quickly and easily. Ideas for consolidating necessary equipment and materials into

[5] The U.S. Department of Veterans Affairs offers balance and motor skill assessments for veterans to prevent falls at home. https://www.patientsafety.va.gov/veterans/falls.asp

a central location to minimize multiple trips to various areas within the kitchen or bathroom were discussed extensively. In addition to efficiency, cost and aesthetics were identified as necessary to maximize consumer interest. Having a well-designed cabinet would be irrelevant if consumers were economically opposed to the price point and/or turned off by the look of it.

Safety concerns surrounding this population also informed the conceptual design process. Mitigating risk factors for falls and reduction in general surface clutter were discussed extensively. These topics were the precursor for many of the proposed features of the cabinet unit.

Through many hours of discussion and oversight from the Home Innovation engineers, the panel identified the following criteria for a ready-built, all-in-one cabinet unit:

1. Effective – facilitate daily tasking
2. Low-cost – as compared to standard cabinetry/remodeling
3. Attractive – aesthetically appealing and blends well into existing areas
4. Modular – easily incorporated into existing spaces
5. Maximum storage and work surface for performing tasks
6. Integrated power and task lighting to minimize cords and obstacles
7. Power supply for plugging in periphery devices (phones, computers, etc.)
8. Adjustable dimensions (length/height) to customize for user
9. Wall or floor mount anchor points to provide options for different installation areas
10. Pre-installed options/accessories
11. Island or series design

EVOLUTION OF PROTOTYPE

With the primary goals identified by the SME panel, Home Innovation partnered with a small design/manufacturer, Ferris Cabinets, who created the cabinet units from the conceptual requirements provided. Since kitchen areas are more spacious and versatile than bathrooms, and they are typically utilized more often throughout the day for tasking, the panel and manufacturer focused on development of cabinetry intended for that area. Conversion of the kitchen cabinet units for bath use could then be done easily with minimal design alterations and simple hardware/accessory changes.

Ultimately, three generations of cabinet prototypes were produced by Ferris Company. Each generation of cabinetry was assessed by the SME panel and Home Innovation engineers for functionality and aesthetics. Feedback was provided to Ferris Cabinets, who then incorporated design updates into subsequent iterations.

First Generation

The first generation of cabinetry provided by Ferris Cabinets delivered three core modules designed for standing activities in the kitchen. Priority was given to the following characteristics: sturdy materials; ergonomics; attractiveness; modular; standard yet customizable sizing; and adequate work surface that was functional for tasking.

Figure 1. First Generation Cabinet Units

The initial design featured integrated lighting and utilized a combination of hand holes and grab bars to provide a means for users to grip and stabilize themselves. The units also contained a built-in power supply that could be plugged into a normal (US Standard 120V) outlet and subsequently power small, electronic periphery accessories and appliances.

The SME panel noted that features in any one module should be easily incorporated into another module, based on consumer customization and tasking requirements. If a consumer's main tasks were making sandwiches and paying bills, the backsplash for a desk could be incorporated with either base unit to create a pantry and office workstation. To facilitate this change, hutch heights were adjusted and dimensions updated in the second build.

In addition to the hutch height change, the SME panel identified several design features that needed improvement after assessing the first prototype. They noted the units had rough edges, clunky drawer mechanisms, and wasted space. It was also initially hoped that the modules could offer space for small kitchen appliances, such as a microwave or mini-refrigerator, but they found the space required for appliances severely impacted the functionality of the cabinets. These were all taken into account in the second generation.

Second Generation

The second generation of units provided by Ferris Cabinets eliminated the appliance base and added two desk designs, resulting in four core units. The SME panel felt this series of cabinets presented a more polished design that more fully embodied their concept and overall goals.

Figure 2. Second Generation Cabinet Units

Design updates incorporated in the second build were as follows:

- Strip lighting (in lieu of a lamp)
- Removal of extra vertical drawer pulls

- Maximization of space for tasking and storage
- Rounding of edges to avoid pinching and poking
- Varied heights for desktops to accommodate sitting and standing functions

With features that more closely matched the objectives of the project, the SME panel's evaluation of the second iteration focused more on ergonomic customization of the features to best suit user needs. The group considered including a pull-out seat for the desk feature, but concluded that it would be too cumbersome. A regular kitchen chair was determined as best suited for use with desks. The depth of the sitting desk was then shortened 2 inches to allow a standard chair to be pushed flush and out of the way when not in use. This change would eliminate the chair as a tripping hazard while users maneuvered past the desk unit.

During this round of evaluation, the SME panel also determined that while useful, the strip lighting added to the price point significantly. With the ability of the module to offer power, after-market lighting would be a less expensive option for consumers. It was decided that consumers should be able to have the choice of lighting most practical for their budget needs. To support this option, cabinet units would need to be able to "piggy-back" power from one module to the next so they could easily connect via their power modules if installed in series. This design change was incorporated into the third generation by integrating grommet holes that allow power cords to run through the sides of the cabinets. Consumers purchasing single modules could request to omit this feature if deemed unnecessary.

The SME panel noted several concerns about the safety grips on the second-generation designs, as well. First, the grips were installed internally, which required significant time investment by the builder. While

a nice feature aesthetically, this mounting method added cost with no real value. The group requested the design be updated with externally-mounted hardware in the final build. Second, the safety grips interfered with operation of drawers and cabinets, creating pinch-points and potential safety and use issues for consumers with poor grip strength. Resolution of this concern was incorporated in the final build by creating cut-outs for hand holds. This design update made opening drawers/cabinets easier for those with arthritis, eliminated hardware giving a lower cost, and provided clearance for hands to avoid the pinch-points identified by the SMEs.

Finally, drawer features were updated based on SME evaluation. Because the push-to-close feature was difficult to use, it was eliminated in the final generation but made available as an option. A lock system was also added so that accidental drawer closing would not result in pinched fingers or hands.

Armed with abundant feedback from the SME panel, Ferris Cabinets updated its design and provided the third and final generation of cabinet units for evaluation.

Final Assistive Cabinet Unit Design

The final design of assistive cabinetry included updates to the units presented in the second generation.

Each cabinet unit offered a range of functionality, maximizing work surfaces and storage. The ability of the cabinets to plug into a standard 120-volt wall outlet negated the need for installation by an electrician. The cabinet unit design was stand-alone, rendering building permits and inspections unnecessary.[6] The cabinet's connectivity and configurability made it suitable for a wide range of user sizes, heights, and abilities.

Figure 3. Final Assistive Cabinet Units – Pictured left to right:
Unit C (with backsplash E), Unit B, Unit D (with backsplash F), Unit A

Veterans and Service Members can benefit from the enhanced functionality of these thoughtfully-designed cabinet unit(s) that quickly turn inadequate kitchen or bath areas into useful, accommodating spaces, putting the user back in control. The technology is unique because it:

1. Is designed for users with general weakness and impairment (not specifically for ADA/wheelchair users)

[6] Always check local building codes in your area for direction.

2. Can modify an existing kitchen or bathroom layout inexpensively, quickly, and cleanly by providing a new, stand-alone workstation
3. Is a focused solution that concentrates the most important functionalities in a purpose-built unit, with dedicated lighting and power, and can be adjusted for specific needs/expanded with additional units
4. Is delivered as a complete cabinet unit (base and counter), with minimal install/set up to attach anchor points
5. Consists of modular, reinforced designs with supportive hardware that allows for placement of cabinetry to assist users with mobility issues
6. Is designed to plug into a standard wall or ceiling outlet (120V), and provide integral power strips and task lighting (NOTE: units contain power blocks, not batteries)

Consumers are given significant options to customize the cabinet units for their specific needs through manufacture or after-market accessories. Customizable features include:

- Color, finish of cabinet face/handles
- Backsplash design for use with magazine holders, other after-market containers/accessories
- Adjustable shelving on backsplash
- Soft-close feature for cabinets and drawers
- Push-to-open for cabinets and drawers
- Heavy duty grip-style hardware
- Lighting features – incorporated strip or after-market lamps
- Space options for refrigerator (cold drinks/insulin) and/or microwave
- Length/height of modules (depth needs to remain the same to allow for standard market features)
- Adding sides to desk units to make free standing
- Single function module or install in series with remodel/removal of pre-existing cabinetry

RECOMMENDED USE

There are four cabinet base units included in the design schematics – two desks and two cabinets. The backsplash plans can be used with any base, per customer choice. The four base units are as follows:

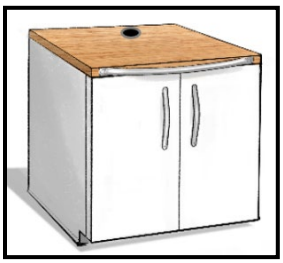

Figure 4. Unit A

Unit A is a cupboard base with six drawers behind its two outer doors. This unit can be customized internally with standard, after-market accessories to enhance its functionality. This unit maximizes work surface and storage and, when equipped properly, is suited for many different tasks. It is designed to support the weight of the user while performing standing tasks. This base transitions well into the bathroom (Fig. 5).

Figure 5. Unit A Modification for Bathroom

Figure 6. Unit B

Unit B is a base model providing three drawers and a cupboard. This unit is suitable for storing silverware, pantry items, and other useful gadgets as needed in the kitchen or bath. When extended out, the top drawer offers additional work surface and a locking mechanism so the drawer cannot be pushed in unintentionally. This unit can be customized internally with standard, after-market accessories to enhance its functionality. This unit is designed to support user weight while performing standing tasks.

Unit C is a desk model with two drawers, stability bars, and a backsplash. The backsplash has adjustable/removable shelves and hides the unit's power pack, which pulls out for easy access. This unit divides surface space with storage functions, and is suitable for tasks such as paying bills, reading mail, writing, making a sandwich, etc. When extended out, the top drawer offers additional work surface and a locking mechanism so the drawer cannot be pushed in unintentionally. This unit can be customized with after-market accessories to maximize functionality, and is designed to support user weight while performing standing tasks.

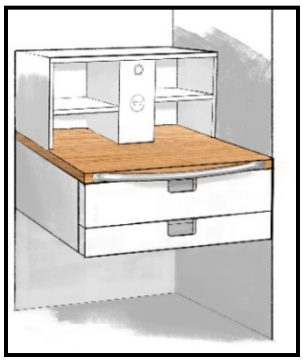

Figure 7. Unit C with Backsplash E

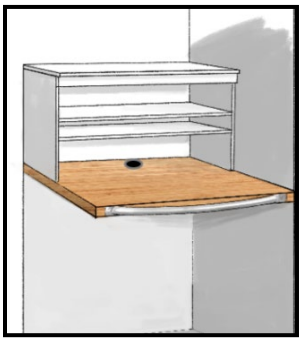

Figure 8. Unit D with Backsplash F

Unit D is a sitting desk model. This unit offers a stability bar and a back splash. The back splash has adjustable/removable shelves. This unit is recessed two inches, to allow a standard kitchen chair to be pushed in, completely out of the way when not in use. This unit is suitable for performing tasks such as paying bills, reading mail, writing, using a computer, etc. This unit can easily convert to a bathroom vanity, as well.

MANUFACTURER CONSIDERATIONS

These cabinet units will require professional cabinet manufacture, delivery, and installation at the consumer's residence. Thorough evaluation of consumer requirements and exploration of desired customization of features should be completed before commissioning any cabinet unit build, so that the specific cabinet unit model can be identified.

All cabinet units share these customizable features:

- Construct Material
  - Must be heavy grade and able to support weight of consumer
- Paint finish/color
- Hardware style
  - Safety bars must be heavy grade and able to support weight of consumer
- Hardware finish/color
- Length – adjustable for area
- Height – adjustable to user
- Install style (island or series)
  - Install with side grommets
- Lighting
  - Incorporated strip lighting
  - After-market lamps

Units A and B support standard cabinet and drawer accessories. If using Unit A in a bathroom, manufacturer consideration should be given to sink installation. Plans need to be updated appropriately and the "pantry" accessory removed to accommodate the drainage pipe.

Unit C supports standard drawer accessories.

The backsplash on Unit C and Unit D has adjustable shelving that can be configured for use with other units and customized for the specific needs of the consumer.

Figure 9. Standard Eat-In Kitchen (Photo: Ed Steinfeld)

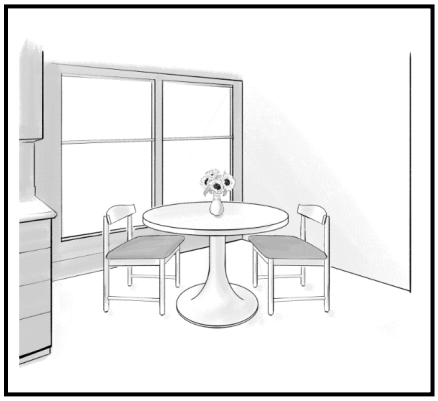

Figure 10. Sketch of Eat-In Kitchen

Installation

Each cabinet is designed to provide stability to users and must be anchored to the floor or wall. Attachment points are noted on the schematic plans provided by Home Innovation. Cabinet units are designed to be installed individually but can be installed in various configurations in series as space permits.

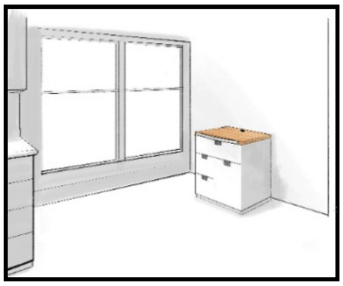

Figure 11. Unit B Configured as Single Unit in Kitchen

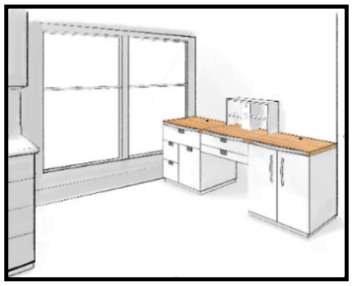

Figure 12. Unit B, C, & A Configured in Series in Kitchen

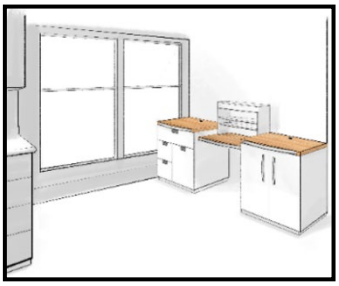

Figure 13. Unit B, D, & A Configured in Series in Kitchen

Pre-existing cabinets can also be removed to allow for install of base units as pictured below. When installing in this manner, consideration should be given to the existing under-cabinet conditions, as the height/level in older homes may distort the new units, or different flooring under the old cabinetry may cause distortion. Correction of these conditions is necessary prior to install and may affect cost.

Figure 14. Home Photo of Pre-Existing Cabinet (Photo: Ed Steinfeld)

Figure 15. Unit B Installed in Place of Pre-Existing Cabinet

Cost

The suggested retail price for each of these cabinet units is between $900 - $1,500.[7] A significant cost savings could be found if cabinets were mass produced. Manufacturers would be able to maintain inventory stock on hand and provide installation to consumers more quickly. Cursory research has estimated the minimum quantity needed for mass production is 15 units.

Construct material will affect the cost of these units significantly. Due to the assistive nature of the units, sturdier materials are necessary to support the potential body weight of consumers, who may need to lean on safety bars while traversing the functional area or standing during task performance. The need to securely anchor the unit during install should be noted as well, for the same reason. Unit plans provide location of anchor points for securing to either floor or wall.

These cabinet units are designed to be installed as a stand-alone island or in series. The determination of installation style should be based on the available space in the consumer home and/or whether pre-existing cabinetry will be removed/replaced by the new cabinet unit(s).

NEXT STEPS: WHERE DO WE GO FROM HERE?

Our research findings indicate that there is value in having cabinets with mobility features available for purchase. However, the challenge of making these cabinets widely available in the marketplace is a question of market demand. Large manufacturers will insist on knowing there is a demand for these assistive cabinets before they make them widely available at the best price.

A future research project for the VA to consider is capturing potential demand data from Veterans. This information can be captured through a market research survey of potential users of assistive cabinets.

To launch assistive cabinets beyond a custom cabinet purchase option, identifying the appropriate VA grant programs for funding is essential because Veterans will need to know what grants[8] can be used within the Home Improvements and Structural Alterations (HISA) Grant. If only one cabinet is needed, then it can be purchased within the $2,000 to $6,800 benefit range (provided the cabinets are widely available) currently allotted through this program.

Currently, these assistive cabinet solutions may be incorporated into the VA's Veteran Readiness and Employment (VR&E) program[9] that helps Veterans live independently.

[7] This price will vary based on consumer choice of specific unit, customization and installation requirements.
[8] https://www.benefits.va.gov/BENEFITS/factsheets/homeloans/SAHFactsheet.pdf
[9] https://www.va.gov/careers-employment/vocational-rehabilitation/programs/independent-living/


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