The Command Chair

…an opportunity evaluation

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1. Introduction – The Command Chair

The Command Chair represents a portion of Dan Odell's Ph.D. research in the area of Human-Computer Interaction (HCI). It consists of two articulated armatures that attach to an office chair and function as arm rests. At the end of each armature is a keyboard half that has been modified to incorporate mouse buttons. The armature tracks the arm motions of the computer user, and uses this input to move the mouse pointer.

In addition to being a useful research tool, the Command Chair has many ergonomic advantages over existing computer interfacing methods. First, it tends to relieve strain from the smaller muscles and tendons and shifts it to the larger groups. It does this by forcing the user to move the entire arm for data entry, rather than just moving through the range of motion of one small joint (as in a mouse). Second, it aligns the wrist into a neutral position. The positions of the elbow and wrist rests are perfectly aligned, preventing any wrist displacement (deviation, extension, etc.). Next, it allows for more adjustability and flexibility in workstation design by decoupling input devices from the desktop writing surface. Finally, it couples all input devices into a single system. This prevents problems such as the commonly experienced issue of the keyboard and mouse occupying the same ergonomically ideal space. All of this leads to the claim of the Command Chair.

For computer users who are at risk of Repetitive Strain Injuries (RSIs), the Command Chair is a keyboard/mouse combo that provides proper arm support and alignment. Unlike other alternative input devices, the Command Chair properly aligns the user's arms to improve comfort and reduce the incidence of RSI.

2. The Pain

Some of these design problems in other existing devices have led to the problem of Repetitive Strain Injuries (RSIs), also called Cumulative Trauma Disorders (CTDs). These injuries are due to overuse of muscles and tendons, resulting in soft tissue damage over long periods of time. Well-documented examples of these diseases include Carpal

Tunnel Syndrome, Thoracic Outlet Syndrome, and deQuervain's Syndrome. These injuries can be very painful, and are potentially disabling.

In addition to causing injuries in individuals, RSIs can be very costly for corporations as well. The General Accounting Office (GAO) recorded 308,000 injuries in 1995 that were a result of repetitive motion, accounting for 60% of all work-related recorded illnesses, and 32% of injuries resulting in days away from work. While injuries due to typing or computer interfacing are a subset of this number, the number of injuries remains very large. Estimates presented by the GAO indicate that the total cost of RSIs to businesses is around $20 billion total annually (August 1997). A portion of this cost is related to lost workdays. The Bureau of Labor Statistics reports that the average time away from work as a result of injury from repetitive motion was 18 days in 1995. Additional cost is incurred by worker's compensation; which the National Council on Compensation Insurance reports costs an average of $29 thousand per claim. Other costs include disability claims, lawsuits, medical costs, and reduced productivity, among others.

3. Stakeholders

The four major external stakeholders of the Command Chair include: individual computer users, businesses, insurance companies, and government. Each of these defines value in a different way.

1) Individual computer users are primarily interested in their own comfort, and preservation of their health. In addition, they may seek to recover or prevent injury due to repetitive strain.

2) Businesses are more interested in the loss in productivity associated with RSI. They seek to minimize lost workdays, and improve employee performance and stamina. They are also concerned with paying high insurance premiums and worker's compensation.

3) Insurance Companies' concern lies in reducing costs. This can be achieved by reducing medical costs, workers' compensation claims, and injury lawsuits. Insurance companies may be willing to offer lower premiums to companies with a better track record of addressing ergonomic issues.

4) Government is concerned with maintaining the health of its communities. This interest is summed up by a recent quote from Labor Secretary Elaine L. Chao on April 18, 2002: "We are serious about reducing injury and illness rates related to ergonomics as quickly as possible."

We believe that the Command Chair addresses the interests of each of these parties and therefore represents an opportunity. Table 1 summarizes these benefits.

The value proposition seems to be of more benefit to businesses than individuals. This is because individuals tend to work for less time on their home computers than they do at work, reducing the likelihood of injury. Further, individuals do not assume the costs

associated with injury, such as lawsuits and worker's compensation insurance. They may, however benefit from the increased productivity aspect of the product.

In addition to the benefits stated in Table 1, individuals and government will have an interest in the health and safety aspects of the Command Chair. These issues are reflected as costs for businesses and insurance companies, but the pain and disability associated with RSI may be a more compelling value proposition for individuals.

Stakeholder	Enabling	Cost Saving	More Productive
Computer Users	??	No	Yes
Insurance Companies	No	Yes	No
Businesses	No	Yes	Yes
Government	No	Yes	No

Table 1: Summary of Stakeholder's Benefit

4. The Purchase Decision

The same pattern of purchasing was found in all of the companies that we interviewed. The purchase decision to acquire a new input device or other piece of office equipment usually is initiated with an individual employee who is experiencing some discomfort. The desire to make the purchase is then stated to either business management or a purchasing department. The employee is then supplied with catalogs of preferred vendors (who usually have offered special discounts to the company), or a list of approved or recommended ergonomic products. The employee usually then makes the purchase from this list, as purchases of equipment not on the list have a much more complicated purchasing procedure. Purchases over a certain dollar amount (typically around $1500) also require a special purchasing procedure. So – as an alternative input

manufacturer – our main interest is in how to get on these preferred vendor or approved product lists, and how to increase awareness among employees of the available alternatives.

While we will need to pursue achieving preferred vendor status with many companies in order to be successful, there are other influences on businesses in determining which ergonomic products they will select. The first comes from government regulation. On a national level, President Bush recently vetoed legislation presented by OSHA to update the standards last set in 1988 in ANSI standard HFS100-1998. However, OSHA is still actively modifying the legislation to present again. This legislation may set some standards that businesses will be required to follow with regards to workstation setup and design. In addition there are many layers of local government (e.g. Cal-OSHA) that may implement workstation design guidelines at the local level. If such standards are set, it will be important that the Command Chair follow these standards. Additionally, it may be possible to get certification as a recommended or acceptable product under the new guidelines. Such legislation would put extra pressure on businesses to consider the Command Chair as an alternative to traditional input devices.

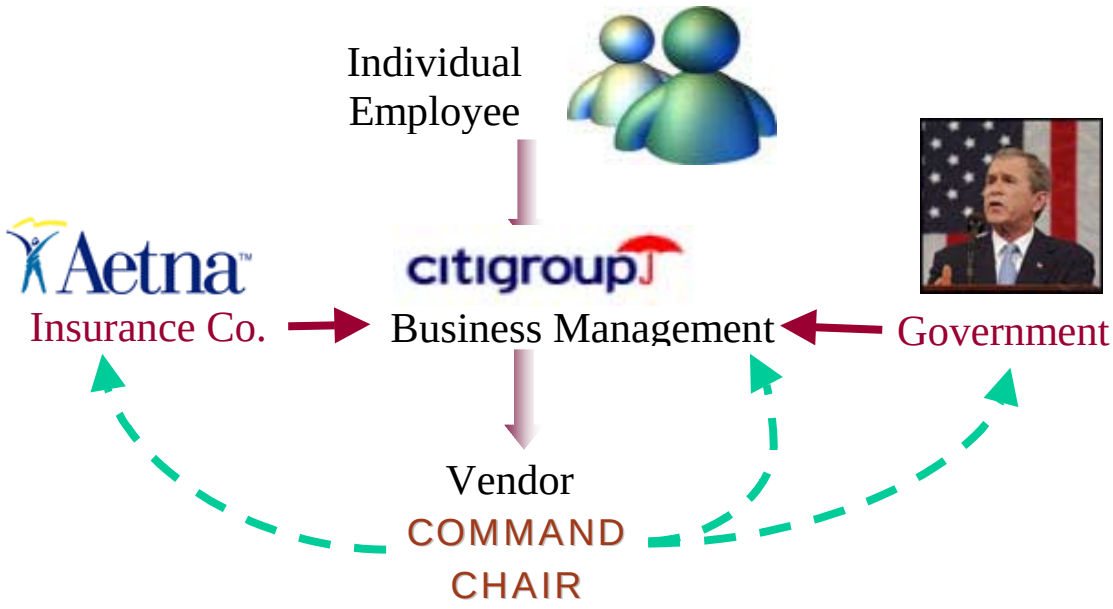

Figure 1: The "Command Chain" for Purchase Decisions

Insurance companies may exert further pressure through discounts in insurance rates. This pressure may be especially intense for businesses that self-insure, such as U.C. Berkeley. These could be offered as incentives to businesses that adhere to ergonomic guideline as a means for reduced insurance medical costs, or possibly worker's compensation costs. An analogy to this would be the discounts offered to auto drivers who have air bags or anti-lock brakes. An alliance with such insurance companies would require us to demonstrate that our product can lower overall costs.

One other pertinent observation we made in our interviews with ergonomics experts and purchasing staff at IBM, Clorox and the Tang Center, UC Berkeley was that cost was considered to be a minor issue in the ergonomic input device purchase. Concerns about employee health and comfort (and avoidance of potential legal conflicts) far outweighed the issues of purchase price, even when the unit cost was as high as $1300. This issue was addressed more through preferred vendor relationships than with limiting worker selection.

5. Customer Needs

Having looked into the purchasing chain, it is important to clearly distinguish between the different groups that are primarily addressed by the "command" chair. They are classified as end-users and customers. While the end-users refer to computer users such as data entry users and graphic designers, the customers include the businesses and corporations where the end-users work. In a study by Key-Bowl regarding keyboards, the following were identified as end-user primary needs:

- Elimination of wrist fatigue (44%)
- Built in wrist rest (22%)
- Key feel (22%)

To the businesses, RSI poses a considerable cost that they would like to circumvent. As previously mentioned, the cost is due to workers compensation or the costly litigation procedures that they may be drawn into, among others. They seek to provide a safe working environment, reduce costs, and increase productivity.

One area where the Command chair may be able to provide demonstrable cost savings is in the area of worker's compensation costs. Currently, The average American business pays almost 5.5 % of its pre tax corporate profits for workers compensation insurance (from Chubb group of insurance companies). The exact rate is determined by the occupations of the employees, and something called an "experience modification." This modification represents a credit or a penalty in worker's compensation costs based upon a three year rolling average based on the frequency of claims of a particular company relative to their industry standard. There can be a lot of variability in this rate, and modifications of a 75% penalty, or a 50% credit are not uncommon. This represents a potentially large cost savings that we may be able to demonstrate to a company; particularly if our product is recognized by the NCCI.

6. Competition

Input devices for desktop application can generally be divided into two main segments, i.e. keyboard and pointing devices (or combination). Another increasingly popular segment is the voice/speech recognition segment, which may become a serious threat to the keyboard as an alternative input device. Other alternatives such as mouse clicking software, screen reading software, low vision software, etc. are too small in size, thus will not be considered in this paper.

Logitech is the biggest player in generic keyboard and pointing devices. Fiscal year 2002 net sales stood at $944 million (28% increase over last year's), of which approx. 34-36% are for mice (though it is declining in share). The company has been very aggressive in diversifying its products, notably in the cordless input devices and PC video camera segments. It also has started playing in the ergonomic fields, focusing more on ergonomic pointing devices such as Ifeel Mouse and Cordless TrackMan FX (Optical), the first commercial optical trackball in the world.

Microsoft is the second biggest player in the generic input devices, with sales for input devices of approximately $652MM in 2001, declined 6% compared the previous year's.

Microsoft seems to be losing focus in this segment, which only represents a small portion (less than 5%) of its total consolidated sales. Increasing competition from Logitech and lower OEM sales during 2001 also has negatively impacted the sales. Looking for new venue for growth and margin, Microsoft has also entered the ergonomics segment, through products such as Microsoft Natural (split keyboard), and Microsoft Intellimouse (pointing device).

Despite increasing attention to the ergonomics products by big players, the ergonomic input devices market for desktop application is still very fragmented (please refer to the Market Environment section). There is no single product that dominates the market. This is in a way influenced by the basis for competition and the barriers to entry.

Three most important aspects are observed as the basis for competition:

- ***Ease of use***: Enhancing comfort and efficiency while reducing risk of RSI injuries are the main focus of innovation, leading to many types of products such as vertical, split, tent (keyboard) or cordless, trackball, touch pad (pointing devices). Successful products, however, depends on the perception of 'ease-of-use' of end-users, which tends to be very subjective.
- ***Quality and Reliability***: Input devices are among the most important interface in every workstation and typically used the whole day. Therefore, quality and reliability is key. Many manufacturers offer money-back guarantees to attract potential users.
- ***Utility***: End users are relatively less sensitive to price but conscious about utility, i.e. function/benefit for the price. This explains the wide variation of product prices. A generic keyboard, for e.g., is selling for $25, while Microsoft Natural, a non-adjustable split keyboard, is sold for $40. On the other hand, SafeType, a vertical keyboard, is sold for $400, and in the extreme case of Datahand, an armature-like keyboard attached to a chair, is sold for $1295. Nonetheless, in the case two products share similar functions, price will typically be the most important non-product factor for decision.

In general, the above factors keep the industry from consolidating. Different perception of comfort allows various products to cater different users. Giants like Logitech and Microsoft seems to be more interested in more standardized products with mass production, thus allows them to leverage their strong retail distribution channel. We believe that opportunity therefore remains wide-open for smaller players with more customized solution, serving niche segments.

We consider the following as barriers to entry for ergonomic input devices products:

- ***Technology***: Technology for these products is relatively not capital intensive, as innovation is centered on the ergonomic aspect of products. Innovation in keyboard is relatively less developed than that of pointing devices, mainly due to the rigid configuration of keyboard QWERT layout.
- ***Product awareness****:* Given the fragmented and less developed ergonomic market, awareness for a certain product is typically low. Rarely there has been a major campaign for ergonomic input devices.
- ***Access to distribution channel***: Common distribution channels for ergonomics products currently includes vendor list, mail order, online, etc.

We believe that the current barriers to entry are still relatively low, thus exposing the current players to threat of new entrants. Table 2 below summarizes the competitive landscape:

Type of Competitor	Variety	Players and Prices
Alternative Ergonomic Keyboard	Vertical, Split, Adjusted Split, Contoured, Dvorak system, etc	Kinesis ($230, contoured), Datahand ($1295, split armature attached to a chair, Microsoft Natural ($40)
Alternative Ergonomic Pointing Devices	Cordless, Trackball, Touch Pad	Logitech (iFeel, $40, optical), Microsoft (intellimouse, $70), Kensington (trackball, $50)
Voice Recognition Software	Standard, Professional (Law, Medical, etc.)	Scansoft ($100-995), IBM ViaVoice ($57)

Source: Various company websites

Table 2: Competitive landscape

Going forward, we expect the following:

Increasing barriers to entry. The key is the change in regulation, which may impose a new standard for ergonomic products. This will make it harder for new entrants to claim that their products are ergonomic products.

More emphasis on price, putting pressure on margin. As the market getting crowded, price becomes an increasingly important differentiation within the same segment.

Voice recognition software is becoming an increasing threat to other ergonomic input devices. Currently the major constraint for implementing such product is system requirement and reliability. As technology developed, we expect both issues to be resolved, opening a way to a more widespread use of such application. Having this in mind, we believe that such application can be a complementary product to our command chair, given that our product emphasis more on the pointing device aspect of the input as opposed to keyboard.

7. Market Environment

The number and variety of competitors described above exemplify the fragmentation of the input devices market. Most alternative and ergonomic producers are small, private firms whose products are driven largely by innovation. Their product, pricing, and distribution schemes are vastly different and no one firm has been able to gain a significant market share. This market situation makes entry compelling for the Command Chair but demonstrates how difficult it is over the long run to gain any traction.

The size and growth rate of the input devices market increase its attractiveness. The total keyboard and keypad market was $2.2 billion in 2000 (Venture Development Corporation). Products labeled as ergonomic are growing as a share of this total. In 1999, 21.7% of revenues from keyboards shipped for North American consumption was from ergonomically designed keyboards. The number is expected to grow to 27% in 2004. The portion of keyboards shipped to OEM's (the most common distribution

channel, capturing 81% of sales) that are ergonomically designed increased from 1.2% in 1995 to 9.7% in 2000.

8. Market Trends

Increased government regulation, especially from local, state, and federal OSHA offices plays a major part in a firm's spending on employees' workstations. This regulation exerts a positive influence on the ergonomics market in that all businesses are spending more on ergonomics in order to comply with regulation and demonstrate their attention to the matter. Regulation can also serve as a barrier to entry, though, as "ergonomic" claims may be placed under more scrutiny and it becomes increasingly difficult to label and sell a product as an "ergonomic" device.

Part of the government regulation takes the form of increased enforcement and education efforts. This trend is unambiguously positive as it creates more knowledgeable employees and employers. In effect, government education efforts will unintentionally develop the market, causing even higher growth rates and widening the target customer segment. As businesses look for more innovative ways to comply with regulation and solve employees' health problems, awareness and intent in the alternative input devices market will increase. As firms spend more on ergonomics, more employees will begin to realize that such products are within their ability and right to obtain and requests for them (the start of the command chain) will increase.

More companies are taking part in ergonomics programs as well. Again, this trend is unambiguously positive for the reasons described above. Moreover, participation in such programs provides quantifiable examples of the results a business can expect to see in terms of cost savings and increased productivity by implementing solutions to ergonomic problems. Insurance companies also have access to case studies of such programs and, as the measurable benefits become more widespread, they may adapt their approach toward firms and ergonomic spending.

For all the reasons above, awareness of RSI and ergonomic solutions is on the rise. Firms are increasingly willing to report and treat RSI. Employees are increasingly careful about RSI injury and prevention. This trend supports the market growth predictions above. However, increased awareness has not yet led to a change in the way RSI injuries are reported and tracked. As such, some confusion remains in the reporting structure, meaning that more data points are not necessarily better.

Finally, an increase in the automation of all work tasks means that an increased number of workers are exposed to the hazard of RSI. Data show that RSI has steadily increased over the last decade. Data processing product applications accounted for almost 57% of the total market in 1995 and are forecast to grow at 11.6%. Here, the risk is that a high growth rate and increased incidence of "pain" will attract more competitors to enter the market and the Command Chair will compete with a greater number of alternatives.

9. Success Factors

The single most important factor for success of the Command Chair is proven results. If the competitive advantage is that the Command Chair solves many ergonomic problems simultaneously (where others solve only one), it must be proven to actually do so through testing. If the results do not validate the claim, the Command Chair will be like all other alternative input devices and be left undifferentiated in a crowded market.

Additionally, securing distribution channels is imperative to achieving product sales and market share. The Command Chair must find a place on firms' Approved Product or Preferred Vendor Lists so that employees are able to choose it as their alternative input device. Another possible strategy is to sell through an OEM, such as an Office Equipment Furniture Manufacturer (Herman Miller). Doing so would allow us to sell the Command Chair as a total workstation solution, rather than just an accessory, and in turn increase its effectiveness. A Computer Manufacturer (Dell) would be another appropriate OEM partnership where we can be ship the Command Chair as part of a standard computer package. The OEM channel broadens the reach and higher volume sales than could be achieved independently as an alternative input device vendor.

Once developed, we can work to create barriers to entry that will protect the product's position. By working with government and insurance agencies to become the recommended or standard alternative input device we can not only construct a barrier to entry, but also drive sales to firms acting in compliance with regulation. A patent on the invention will prevent others from copying and attempting to imitate the Command Chair.

10. Risks

The risks are inherent in the success factors. If results do not support the claim and we are unable to secure a distribution channel, it will be hard to reach and satisfy the target market. Uncertainty related to trends in the market will also come to bear on product success. Government regulation in particular will significantly influence the shape of the market and a revised OSHA bill will dictate the way firms approach the health of their employees.

In an informal conversation with venture capitalist Todd Brooks of Mayfield Venture Capital, he suggested that in today's economy, successful business plans must quantifiably solve a customer pain. We must be able to go to the market and say, for example, "The Command Chair has been proven to cut the incidence of RSI by 20% which will, in turn, reduce the amount employer's pay for workers' compensation by 33% over three years," as opposed to, "The Command Chair is ergonomically correct and feels good." Ultimately, the question remains, is the Command Chair a "vitamin" or a "medicine"?

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References

Bi-Manual Interfacing

1. "A study in two-handed input"<http://billbuxton.com/2hands.html>
2. " Two-Handed Input in a Compound Task"<http://billbuxton.com/2hCHI94.html>

Competing products

1. Kinesis Corporation (privately held) www.kinesis-ergo.com - Contoured, split keyboard
2. Cirque Corporation (privately held) www.cirque.com - Supplier of consumer and OEM input devices
3. DataHand System www.datahand.com - Armature keyboard mounted to chair
4. Goldtouch Technologies www.goldtouch.com - Adjustable keyboard, low-stress mouse
5. Safetype www.safetype.com - Vertical Keyboard
6. Mouse trapper – mobile keyboard http://www.mousetrapper.com/usa/index.htm
7. A summary of many existing devices http://www.billbuxton.com/InputSources.html - anchor245435
8. Elbow rests http://www.buyamag.com/computer_ergonomic_accessories.htm

Distributors of Input Devices

1. Infogrip, Inc. (privately held) www.onehandkeyboard.com
2. Key Alt (privately held) www.keyalt.com - Distributor of ergonomic products

RSI Reports/Statistics

1. MSDs and Workplace factors: http://www.cdc.gov/niosh/ergtxt1.html
2. Keybowl's market evaluation http://www.keybowl.com/ergonomics/keyboards/industry/industry_full_p.htm
3. GAO-United States General Accounting Office, Health, Education, and Human Services Division Report to Congressional Requesters August 1997Worker Protection: Private Sector Ergonomics Programs Yield Positive Results

Worker Compensation Insurance

1. Chubb Insurance www.chubb.com/businesses/workcomp/
2. National Council of Compensation Insurance http://www.ncci.com/

RSI and Ergonomics

1. Links on CTD and RSI http://www.ctdnews.com/web_links.html
2. CTD News http://www.ctdnews.com/
3. Treating and Preventing CTD http://www.ctdnews.com/suffercare.html
4. Ergonomics: Engineering Health and Safety http://www.morencyrest.com/Articles/Ktmart.htm
5. Ergonomic Solutions for the Workplace http://www.ergonext.com/?source=MiQ&effort=29
6. Ergonomics Information (including great info on Workstation Setup Guidelines) http://www.morencyrest.com/ergoinfo.htm
7. RSI Medication http://www.reliefmart.com/Therapain_Plus_Glucosamine_and_MSM_for_Repetitive_Stress_and_Strain_Injuries.htm
8. Adaptive Technology for Information and Computing at MIT - http://web.mit.edu/atic/www/
9. Link to resources outside MIT http://web.mit.edu/atic/www/otherresources.html
10. The typing Injury FAQ www.tifaq.com
11. Computer Related RSI www.engr.unl.edu/eeshop/rsi.html
12. Harvard RSI Action Home Page www.rsi.deas.harvard.edu
13. OSHA Ergonomics Web Page www.osha-slc.gov/ergonomics-standard/index.htm, http://www.osha.gov/ergonomics
14. 10 to know things about RSI http://www.ur-net.com/office-ergo/alternat.htm
15. Ergonomics Society http://www.ergonomics.org.uk/