Generation by Knoll<sup>™</sup> Independent Ergonomic Evaluation

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## Introduction

Knoll, Inc. asked Dr. Tim Springer to provide an independent ergonomic evaluation of the Generation by Knoll<sup>™</sup> chair. Springer is President and founder of HERO, Inc. (Human Environment Research Organization), a consulting practice specializing in research, ergonomics, workplace planning and workplace change management. Its focus is on developing workplace solutions that support work behaviors and yield improved performance.

Springer is recognized as one of the top two or three experts in the world on issues of knowledge worker performance, office ergonomics, work behavior and the work environment. With more than thirty years experience in research and consulting to a wide variety of organizations from Fortune 500 to small start-ups, Springer is one of those rare people who can back up their academic credentials with consulting expertise and real world experience.

This document contains Springer's ergonomic assessment of Generation by Knoll<sup>™</sup>. In this report, Springer not only analyzes the chair, but also provides insights on the current use of ergonomic standards and how the ergonomics of seating is evolving.



# A Note about "Ergonomic Evaluation of Seating"

The trend in office ergonomics is to codify and standardize the process of evaluating seating. Several ergonomists and organizations have published forms and checklists for use in evaluating and comparing chairs. While there is an attempt to include user perception and opinion, the underlying criteria by which these evaluations are made come from either the ANSI/HFES 100-2007 standard or the BIFMA Ergonomics Guide G1-2002.

It's reasonable that these standards should form the foundation of comparative analyses. The standards criteria are largely quantitative allowing the use of uniform measurement and techniques to collect data in the same fashion across multiple chairs.

However, it is appropriate to challenge the underlying assumptions behind these evaluation approaches. If a chair is assessed using any of the checklists, and is given a high rating, does that necessarily mean it is a good chair? Will it meet all the needs of users? Will it avoid causing discomfort? Not necessarily. All one can really say is that it was rated using checklists based on international standards.

# Ergonomic Standards and "Goodness of Fit"

Fundamentally, standards reinforce conformity rather than reward innovation. Standards are by their very nature consensus criteria. Groups of individuals, each representing a different stakeholder with different agendas, eventually agree on criteria that are ultimately compromises. Once in place, standards serve to encourage conformity. Evaluation and comparison of a product address "does it meet the standard?" rather than "does it exhibit innovation in product design that exceeds or transcends the standards criteria?"



Nonetheless, standards exist and are used to evaluate products. If one accepts international standards criteria as sufficient to define the minimum adjustment ranges for office seating (a debatable assumption), then they should serve merely as the baseline for any new office chair. In other words, all new chairs should be expected to meet or exceed the standards criteria. Innovation that enables a product to exceed or transcend the criteria must be considered valuable.

Ergonomic standards are a good *starting point* for the *baseline* dimensions and ranges of adjustment. Beyond that, one must have detailed understanding of who will use the chair, what tasks and activities it is intended to support, and how frequently and for how long users will engage in each activity.

## To simplify, at its most basic level a chair should do seven things:

- + Support the user's body
- + Support the full range of activity the user performs on a daily basis
- + Promote movement
- + Incorporate cognitive ergonomics
- + Support performance
- + Be easy to use
- + Do no harm
- + Support the user's body

The standards address the first criteria—"support the user's body." By providing adjustments, a chair can accommodate the variation in size and shape across the population.

Knoll constructed a matrix showing the dimensional criteria from nine different international standards or guidelines. This spreadsheet does an excellent job of showing how Generation by Knoll<sup>™</sup> meets or exceeds all the known international standards including ANSI/HFES 100-2007 and BIFMA G1-2002.

Meeting the dimensional criteria should be considered the baseline for any new chair. Generation by Knoll<sup>™</sup> exhibited the following characteristics that will allow it to support the users' bodies.

# Active Adjustments

Generation provides three primary "active" adjustments plus optional arm rests that include active adjustment:

## Seat height

Generation accommodates the full range of seat height requirements. This is accomplished by providing a choice of 3 different gas cylinder sizes. For lower seat heights, one cylinder adjusts from 15.0"-19.5". The standard cylinder offers height adjustment range of 16.5"-21.75". For the higher end of the adjustment range, a different gas cylinder configuration provides seat heights from 17.75" to 23.25".

The control mechanism is located on the right side of the seat pan, about where a user's hands would come to rest if allowed to hang downward.





Seat Depth Adjustment

Tilt Preference Selector



**Responsive Back Rest** 

## Seat depth

Generation provides approximately 3" of seat depth adjustment front to back by means of a control on the left side of the seat pan.

Lumbar Support

## **Back rest**

Generation includes an active control that changes the flexion-tension of the dynamic back rest. This control is a small lever located posterior to the seat height adjustment paddle. It provides three detent settings. Because the back rest is very flexible, this is not a "hard" stop, but rather a tilt preference selector. The intent is to provide some additional resistance to a backward leaning position.

## Arm rest adjustments

Optional, high performance arms provide active height (4.5"), depth (1.5" forward-backward), lateral width (2") adjustment similar to that used in the Life chair.

Arm rests also pivot in response to active pressure from the user-for pivot adjustment no control activation is required.

## **Dynamic Response**

Generation is a responsive design allowing the chair to respond to a user's body, position, and motion.

#### Seat

Three sides (all but the back edge) of the seat flex in response to the person's weight and position. Also, the foam in the seat pan will compress offering approximately 1" of additional declination depending on how the user sits.



## **Back rest**

The size, shape and materials used in the back rest of the Generation Chair combine to provide responsive support to conform to a wide range of users' backs. Back rest tilt is 15° to provide dynamic support for forward and backward oriented positions.

The back rest is made of a very responsive material. Since deviation from the ideal curve of the spine is quite common in the general population, this is a very innovative way to provide responsive support for a wide variety of sizes and shapes of users' backs and spines.

Separate and adjustable lumbar support should not be necessary, but the design of the back rest accommodates supplemental lumbar support if required.

The supplemental lumbar support is flexible plastic that rides on a cog-like track. Pushing the device from either top of bottom easily performs height adjustment for this optional support. The teeth in the track provide detent feedback and allow incremental adjustments.

# Beyond Physical Ergonomics and Standards

The international standards and their included dimensions address static measures of body size and the physical ergonomics of accommodating a range of users; however, to fully evaluate a chair, one must look beyond the standards and physical ergonomics to consider what a chair could and should do.

## Support activity



Evidence suggests "desk work" constitutes the majority of activity in most offices. Thus, most chairs need to support forward-directed positions and activities. Traditionally, this has included postures that are forward leaning (writing), erect (keyboarding) or reclined (reading or talking on the phone). However, even for jobs involving one primary activity, most users' days are composed of chunks of primary activity punctuated by frequent interruptions, interaction with others, and a variety of alternative activities. Consequently, a chair must not only support the primary activity, but also *support a wide variety of diverse work activities*. To do so, a chair must facilitate motion and a variety of alternative postures in addition to the traditional "forward-oriented" positions.

Generation addresses this need by providing stable, but responsive, support of the seat and back. The seat flex coupled with the unique, flexible structure of the back allows users to stretch, reach, turn, and lean forward, backward or to the side. The chair moves with the user in a responsive, *non-restrictive and non-constraining way*.

A unique characteristic of the Generation chair is that the top 6.5" of the seat back "folds" backward as pressure is applied to the top of the seat back. This presents an additional support surface and configuration, allowing users to assume a variety

of "non-traditional" positions including sitting sideways, sitting backward with arms resting on the seat back, etc. These positions are commonly adopted by users but seldom accommodated by task chairs.

## **Promote movement**

The designers at Formway and engineers at Knoll recognize the need for a task chair to support and promote motion. Even when sitting still, our bodies move. A good office chair supports the body beyond the





Examples of Multi-Modal Work

static postures on which international standards are based, and includes an understanding that office work requires motion. Generation promotes active motion, providing unobtrusive, responsive, flexible support of users in a wide range of postures and positions.

## Incorporate cognitive ergonomics

Closely related to the need to promote motion, the design of a good office chair should move beyond physical ergonomics and *incorporate cognitive ergonomics*. Cognitive ergonomics focuses on how our minds work and how thought processes influence and affect our behavior.

Cognitive ergonomics includes the concept of peri-personal space—the immediate workspace within sight and reach of an individual. By supporting ease of movement and variety of task positions, Generation allows users to move about freely and easily to access materials and objects within their peri-personal space.

Another cognitive ergonomic concept that reflects how people actually work is that of *multi-modal work*. People need the ability to change easily and seamlessly back and forth between work modes—from focused concentration to engaged, "situation awareness," to collaboration and interaction with co-workers and the surrounding environment. By supporting motion and responding to changes of position without requiring conscious control, the Generation chair unobtrusively supports changes in work modes.

## Support performance

How can a chair support performance? If a chair supports users' bodies, allows them to perform their work without intrusion or hindrance, promotes motion that is a natural and necessary part of work, and incorporates features that support how our minds work, then one would expect it to support performance—if for no other reason than it does not inhibit or restrict work behaviors that constitute job performance. Data suggest investing in well designed and appropriately supportive ergonomic seating can improve performance. However, without field-testing and careful measurement of the impact of the chair on worker performance, it is not possible at this time to state with certainty that Generation by Knoll<sup>™</sup> will improve performance.

## Be easy to use

Generation's active controls of seat height, seat depth and arm rest position are "set and forget" adjustments. The location and activation of the controls are obvious and easy to use. The dynamic response of Generation *enhances ease of use* by eliminating unnecessary thought or action while providing support to user position and motion.



Does the chair *go beyond usability*? This is a harder question to address. It is possible users may enjoy the experience of sitting in the Generation chair. Also, as co-workers see others using the Generation chair in a variety of positions, postures and settings, they may be tempted to experience Generation. In my opinion, the unobtrusive nature of the Generation chair, coupled with its fluid functionality supporting a wide range of postures, comes close to combining usability and pleasure. Time and experience will tell whether this opinion holds true.

## Do no harm

If there is one area where Generation may draw criticism from some parties, it may be its unconstrained support of motion and enabling of various "non-traditional" postures. Some ergonomists argue not all motion is good. They claim people can harm themselves by assuming "higher risk" postures associated with twisting and turning, bending, stretching and reaching. Certainly people can injure themselves in any number of ways. But the idea that chair design can limit or defeat innate human behavior and provide appropriate support of work postures and positions is flawed. Many of the hazards and risks associated with office seating and postures are due to the conflict of restrictive design with innate tendencies of users. It's been said there is no such thing as an idiot-proof system. In my experience, users are very creative in finding ways to overcome or defeat designed-in constraints. Users adopt positions most scientists and ergonomists have never considered. They may look uncomfortable and they may appear to place stress and strain on the body, but one must question who is best suited to monitor discomfort, stress and strain. It seems the height of hubris to suggest designers, engineers or ergonomists could or should constrain or dictate correct postures.

People are very aware. They know when their bodies are telling them something is comfortable and when it is not. People should be allowed to assume postures they feel are comfortable and from which they want to work—without judgment or constraint.

In addition, the design of Generation is significant for its design transparency and the way in which it *applies the latest technologies*. From its inception, Formway and Knoll placed environmental and sustainability concerns foremost in the development of Generation and this attention is demonstrated in the finished product. The use of leading edge materials in new and creative ways coupled with elegant engineering of the mechanisms are central to the functionality of the chair. These characteristics, plus attention to packaging and shipping, minimize Generation's environmental impact.

## Summary and Conclusions

Introducing change and innovation to something as ubiquitous as office task seating is difficult and rare. New approaches often elicit criticism from those who established the existing paradigm and resistance from users wed to existing traditions. The appearance and experience of use of Generation by Knoll<sup>™</sup> is significantly different from other task chairs. Formway and Knoll have changed the paradigm by successfully understanding and incorporating a comprehensive approach to ergonomics looking beyond dated, static, standards and embracing new thinking and new design to provide a more dynamic and responsive solution to office seating.

The innovative use of new materials and technologies is to be commended. As with most innovations, the durability and strength of the product will be tested by users in the field. I'm confident the Generation chair will meet or exceed the requirements—but user organizations may need assurance to accept this innovation.



The Generation chair meets or exceeds all the published international standards for office seating. The ergonomic functionality of the chair illustrates it is both a significant advance in the evolution of office seating and a departure from other chairs. Generation introduces new fluidity and flexibility to the task of sitting and to office task seating through new and creative use of materials and innovative engineering. Generation is a new direction in seating that transcends the traditional idea of office task chairs to provide an unobtrusive, flexible, stable, responsive platform for the new multi-modal environment of office work.

