

# Ecological Niche: Computing, the Social Environment, and Ways of Working

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*Adapt or die.*

—Anonymus

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## DESCRIPTION

There is an interdependency between any system and the environment in which that system operates. While many would regard this conclusion as obvious, it is all too often obscured when we look at the history of computing.

Even considering biological evolution, there is no uniform march forward with new species reliably replacing older species. Some species die. New species emerge. Some species survive countless years. Cockroaches, horseshoe crabs, and tube worms live for millions of years as other species die. In addition, some species change so much that their ancestors would be almost unrecognizable today, eohippus, for example.

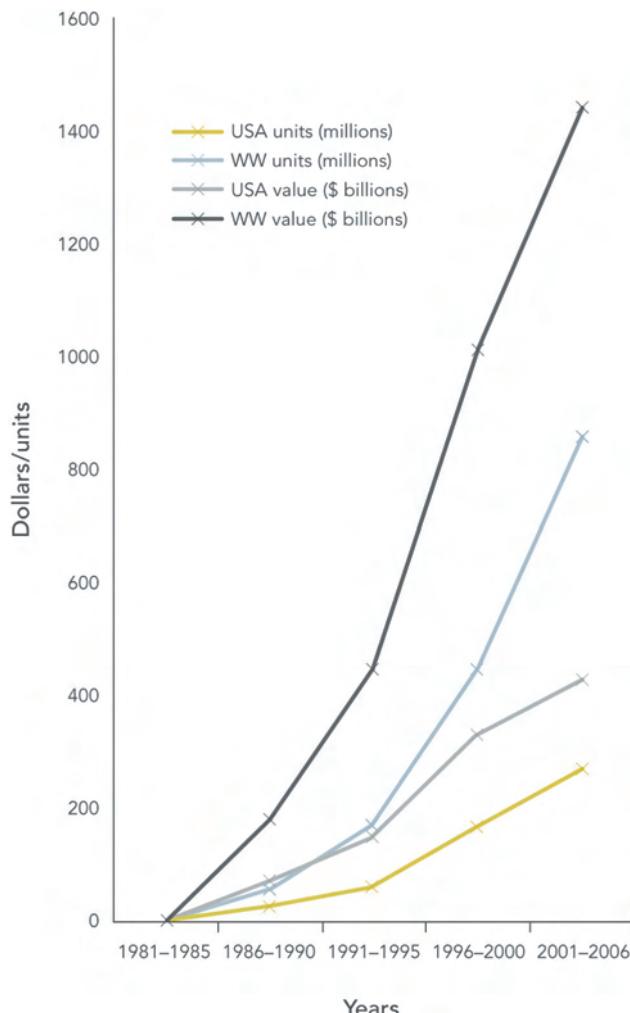
It might be more productive to think of species as fitting into a niche and surviving if their niche endures and if they face “manageable” competition or predation in that niche. This is very different from a “conventional” view of evolution, which sees life as becoming ever more “advanced” and “adapted.” We could call this view the *niche view* and contrast it with the *unidirectional view*, that is, more advanced species uniformly replace less advanced ones.

We can look at the history of computing in a similar way. Conventional wisdom sees computing as “unidirectional,” that is, with each new “generation” the previous generation of computing is swept away, like an extinct species. Applying this viewpoint to hardware platforms, we could conclude that the mainframe was supplanted by the minicomputer; the minicomputer was supplanted by the personal computer in its various forms; and the personal computer will be supplanted by the smaller connected computers or mobile phones. This is a unidirectional view of evolution of hardware.

Some data would seem to support this view, for example, a view of the growth of PC sales in unit numbers and dollar volume in the United States (USA) and the

world (WW) as shown in Figure 3.1—depicts increases of between 4200 and 15,000%!

But did mainframes actually go away? In human-computer interaction (HCI), was the command language replaced by the graphical user interface (GUI)? Will the GUI be replaced by the natural user interface (NUID)?



**FIGURE 3.1**

Sales of PCs.

(From <http://www.thefreelibrary.com/Computer+Industry+Almanac%3A+25-Years+PC+Anniversary+Statistics%3B...-a0149450229>.)

A more careful examination of this history leads to a more nuanced and complex view. In fact, the various forms of computing morph, adapt, and coexist with new forms of computing. For example, the mainframe did not go away as the smaller and more personal computers became popular. Instead, the mainframe continued to exist in its domain, processing large-scale routine jobs (e.g., payroll). The size of the mainframe market (measured in revenue) has been surprisingly stable over the years. The mainframe market and range of its use just seem tiny because they have been dwarfed by an incredible explosion of smaller and more flexible computers. Factors such as low cost, wide range of applications, and an ever-increasing ease of use worked in true synergy to make these personal computers ubiquitous. Ironically, medium-size computers morphed into server arrays where they connect smaller and cheaper computers into useful networks. So we see great growth in the number of and value of new hardware platforms that support a wider range of activities.

The same kind of evolution exists in the human-computer interface space. Command languages continue to exist in the form of programming languages and command procedures and as a way to execute more specialized and technical operations. Considered broadly, there are more commands running computers than there ever were. Every equation in every spreadsheet is a command, and the universality and power of command systems are surprisingly large. Within spreadsheets, this “command ecology” coexists with a GUI ecology of pull-down windows, icons, and menus.

The apparent ubiquity of the graphic user interface stems from several sources. First, the GUI is well suited to office work, where it is ubiquitous and obvious. Many people labor in cubicles and offices using GUIs and are painfully aware of the interface they are using to access functionality they need. Interestingly, there is as much or more computing power and as many hours of use in the population of gaming consoles as there are in personal computers. Gaming is very widespread. The consoles are very powerful. Game players spend a lot of time playing games. We might group the various gaming system interfaces as the fun user interface, or the FUI. Unlike the GUI, the FUI is mostly invisible to players. They are immersed in the game. Similarly, almost everyone who uses a computer today interacts with the World Wide Web in one form or another. The web presents its own unique interface of links that change the content of the display and the available choices (links). The interactive element links are spread throughout the page and not confined to a menu bar or button ribbon. We could call this interface the web user interface, or the WUI. The WUI and the FUI peacefully coexist and in some cases (e.g., World of Warcraft) work together to the users’ delight.

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## APPLICATION TO NUI

The historical context outlined above gives us a vantage point from which to consider any natural user interface.

First, despite the enthusiasm of its proponents, the natural user interface will not supplant the GUI. The GUI is too well adapted to its ecological (i.e., business and

social) niche of office work. Keyboards and pointing devices serve the office worker very effectively. A NUI would be out of place. Imagine typing a long report on a virtual keyboard. That said, the NUI will create a new “niche” of computing. How large that niche will be is impossible to say at this time. The NUI is like the GUI in that both are examples of an underlying driver that is expanding the overall computing universe in terms of both size and range/diversity. This underlying driver is the reduction in time and effort that users incur in adopting new ways of interacting with machines. In other words, as the barriers to functionality contained within, or the fun enabled by computing, are reduced, the scope of computing is expanded. Second, the NUI and the GUI will likely coexist, leading both to prosper. For example, the NUI is well adapted to the niche of leisure and entertainment. There the NUI contributes to the fun of viewing content, for example, pictures, or playing games. At the same time, the content comes from the GUI world of transferring photos from cameras to computers. The games are developed using GUI and command systems. Considering NUI in the home, we are likely to see an even tighter integration, for example, someone browsing the web for pictures, downloading them, then manipulating them using the NUI.

The NUI itself may well exist in different “flavors,” much as the GUI systems do. For example, the GUI controls of buttons are readily transferred to control systems on touchscreens in cars. In contrast, the hierarchy of GUI menus and a separate pointing control (usually a joystick-like control that employs pushing and twisting) is not well adapted to a driving environment. Similarly, a NUI interface that works well for horizontal interfaces will be used differently when placed vertically. Horizontally, it is a table well adapted to games like hockey or bowling. Vertically, a NUI would be used more like a white board on steroids, for example, moving and merging content from other sources, or even writing. But we would not expect the sustained and intense use in the vertical form as we see in the horizontal form. Here we see a fundamental principle in action—the new interface accommodates to the traditional use that existed in the “old” environment.

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## LESSONS FROM THE PAST

As we have seen, the past is often misread by the causal observer and the superficial historian. A deeper examination leads to the following generalizations:

- Hardware platforms and forms of interaction do not replace each other as the universe of computing grows. They continue to exist in the “niche” in which they always prospered. Their absolute size (revenue) and range (uses) may be undiminished in an absolute sense but may seem reduced dramatically as new ways of computing and interaction emerge and dwarf them.
- Types of computing often combine into useful hybrids that borrow interface elements from each other to form systems that are well adapted to a particular niche. The spreadsheet, for example, contains command and NUI elements.

- New types of computing often evolve into subspecies that are well adapted to one particular environment or another. Horizontal NUIs will be used differently than vertical ones. This adaptation reflects the constraints of the context and the possibilities that the new interface and technology bring.

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## DESIGN GUIDELINES

In the context of an ecological niche, the design guidelines for the NUI are not different than the design guidelines for any genre of computing. That is, the same general principles apply.

### Must

- Consider the context of use and the new possibilities that the interface brings to interaction in that context.
- Do not simply translate from one genre of computing to another. For example, copying a web application to a NUI will result in an interface that does not exploit the possibilities of the NUI.

### Should

- Be aware that in different environments the patterns of use of an interface may be dramatically different.

### Could

- If the context demands it, consider a judicious mixing of interface elements from various styles. This is risky and needs to be done with care.

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## SUMMARY

The NUI may represent a revolution in computing, not because it replaces existing ways of interacting with computers, but because it enables computing to expand into new niches that could be of tremendous size and importance. Like previous interfaces, the NUI draws its power from reducing interface learning cost. Finally, the NUI will evolve into subspecies that will be well adapted to given social and business niches.