Nanotechnology:
Its Impact on Human Resources Management & Organizational Leadership

by
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Nanotechnology will have a profound impact on the world and our society. Among other changes, our personal lifestyles will be transformed and how businesses are operated will be revolutionized.

According to most estimates, we are still at least a decade away from the reality of first significant changes resulting from nanotechnology. But scientists and other technical experts are rapidly moving forward with their research and development efforts. The importance of these efforts is underscored by the fact that the U.S. Congress has already allocated billions of dollars to fund exploration of nanotechnology.* The federal government recognizes the need for the U.S. to keep abreast of the progress of nanotechnology explorations – not unlike exploration of outerspace - in an attempt to maintain leadership in the competitive global economy.

What is *nanotechnology*?

Nanotechnology is similar to microtechnology, the technology of microelectronics used for modern computers. Nanotechnology is essentially the technology that attempts to utilize subatomic objects measured in nanometers. Many scientists claim that this new technology will have greater impact on the world than did the impact of "DOT.Com" industry (sometimes more recently referred to as "DOT.Gone industry") at its peek.

To get a sense of the size of *nanometer*, it is helpful to review our understanding of certain other measurements.

A meter is a little more than 3 feet (39.37 inches). One thousandth of this length is a *millimeter* (25 millimeters equal about an inch.) *A micrometer* is a millionth of a meter (about the width of the tip end of a paperclip); If you can imagine, *nanometer*, also known as a "micron", is about a thousandth of a micrometer (about one thousand times smaller than the tip of a paperclip or the diameter of a human hair).

The 1995 Pentium computer chip is about the size of 1/3 of a micron, or 350 nanometers. Currently advanced computer chips are even smaller, almost 1/10 of a micron (i.e.100 nanometers). So, a nanometer computer chip would be 100 times smaller than modern computer chips used today. You realize that a nanometer certainly is not visible to the unaided eye.

How Will Nanotechnology Help Us?

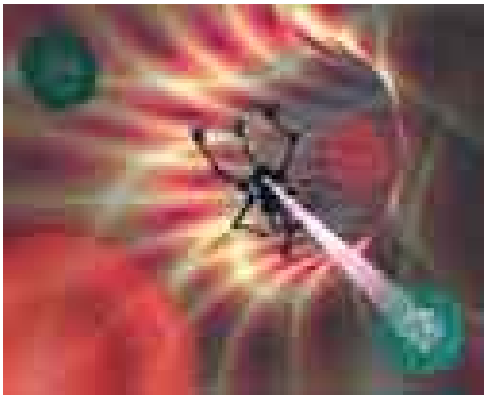
Nanotechnology will have many applications in business, medicine, public services, and elsewhere. Besides allowing us to manufacture much smaller computer chips, it will allow us to arrange atoms and molecules on a "submicron scale". (There are only 3 to 5 atoms in a nanometer. (*Nanosystems: Molecular Machinery, Manufacturing, and Computation,* by E. Drexler, Wiley 1992).

One of more fascinating possibilities involves the ability of nanotechnology to produce robots that may self-replicate. These submicron fabricated robots, programmed with submircon computer chips to reproduce themselves, could be injected into the blood stream to perform non-invasive surgeries, genetic tests, and similar tasks. "Nanobots" may be able to eliminate different cancers, infections, and numerous other diseases, as well as perform repair functions far faster than the natural healing process by working within the bloodstream, organs, and body tissues.

How do we know nanorobots can be developed? None have actually been built – yet. Because much of the literature on the short term application of nanotechnology frequently mentions this focus of research and development. For example, Robert A. Freitas, www.webmaster@foresight.org , claims to have designed an artificial mechanical red blood ("respirocyte"). It would float in the blood stream as a tiny pressure tank filled with oxygen and carbon dioxide. The intent is for this nanorobot to be programmed to release gases into the blood and lungs in a controlled manner to facilitate oxygenation in patients with lung and blood diseases. (Also refer to "Introduction to Nanotechnology", by Eric Drexler *in Prospects in Nanotechnology: Toward Molecular Manufacturing,* Wiley & Sons, 1995 for more details.)

Medical nanodevices are being researched and developed because of their many useful capabilities without invasive surgery. Some of these molecular devises would be able to swim through blood, crawl through body tissue or along the walls of arteries. Nanotechnology may give us the preliminary ability to build molecular machine systems, robotic arms shrunk to submicron size to pick up and assemble molecular parts. In other words, these systems may be able to perform many medical tasks *inside* our bodies. If we can arrange atoms into molecular computers, then a whole range of other molecular products and robots can also be arranged, such as molecular medicines and revolutionary surgical "instruments". In author/MD Michael Crichton's novel, *Prey* (page xi; Harper Collins, New York 2002; ISBN 0-06-621412-2), he states "Pundits predict these tiny machines will provide everything from miniaturized computer components to new cancer treatments.."

Nanotechnology as applied to medicine, i.e. *nanomedicine*, would utilize nanorobots including: Micro-Medics 2; T4 Bacteriophage; T4 Bacteriophage; Immune Machines; DNA Repair Machines; Cell Repair Machines; Bloodstream Micro-Medics; Lung Cleaners; Artery Cleaner; Bloodstream Hexabot; Peepers I; and Drillers. Research predictions are that these programmed nanorobots may eliminate need for invasive surgery, and revolutionize administration of prescription drugs when injection into our bloodstream. They may perform various functions such as cleaning arties and lungs, repairing diseased organs, and providing more effective immunizations. (No more lost sponges in patients?).



Bloodstream Hexabot

(http://www.foresight.org/Nanomedicine/Gallery/Captions/Image101.html)

Impact on Human Resources Management & Organizational Development?

Knowing that there will be profound impact, need business organizations prepare for the inevitable changes? Should professionals be concerned? After all, the impact on society may not be felt for many years yet.

It is suggested that professionals should at least start acquiring a basic understanding of nanotechnology and its potential applications. Adaptability and planning are valuable strengths in a competitive business world. Human resources and organizational leadership professionals must play a significant role in developing these strengths. They are already expected to be strategic partners and "change agents" and, therefore, will called upon to facilitate the process of fully integrating the new science of nanotechnology into the fabric of business organizations. Indeed, HRM is in a unique position to play a major part in assisting with the transition to this challenging new era.

In the short term – possibly a few decades from now – new products will very likely effect our health and environment – both positive and negative . Molecular machine systems may be able to sense and rearrange patterns of molecules in the human body. Thus, nanomedicine will revolutionize the practice of medicine as we know it today. Absenteeism and turnover may be dramatically reduced because lengths of illness and injuries will be much shorter due the significant advances in medicine. Fewer invasive surgeries would be required, resulting in shorter periods of recuperation, enabling quicker returns to work.

Employees may be able to work twice as long without the need for sleep, vacations, or other time off from work; workweeks may thereby be shortened. Medical plans and other employee benefit plans and leave policies would have to be radically changed. (Federal and state job-protection statues, as well as national social policies - would also need to be updated.) HRM will need to be prepared for these and other realistic possibilities that will transform the workplace.

Rapid Changes in Employment Patterns

Just as modern technological changes necessitated industry to quickly adapt to stay competitive, nanotechnology will also require organizations to quickly adapt to changes. Molecular manufacturing is expected to accelerate changes in employment patterns. Workforces will need to be educated and trained.

(Molecular manufacturing is one of the anticipated focuses of research and development because it will allow construction of materials without chemical pollution. Elimination of toxic chemicals via molecular manufacturing, at least in theory, may be accomplished by the recycling of leftover molecules.)

No More Retirements – Work 'til You Die?

Retirement may become an obsolete concept. Already there is a trend toward rehiring more retirees in certain industries because of the lack skilled replacement workers with requisite experience and expertise. "Phased retirements", where older employees gradually transition into a workweek of reduced hours, may become the norm.

With even longer life expectancies resulting from nanomedical improvements, the structure of group life insurance, for example, may have to change. Longer life spans are already impacting the design of employee benefit plans and employee policies, such as discretionary paid leave policies. For example, the age at which full income benefits may be started under Social Security have been pushed beyond the original age 65 standard. Unemployment and workers' compensation benefits may eventually become radically reformed or even obsolete. Vacation, holiday, and other paid time off benefits may have to be drastically changed since most employees would rarely be absent, or may even work for multiple employers. Human resources management and employee benefit record keeping will continue to be more efficient and portable because of new advances in "information nanotechnology". "Paperless" HR departments will also become the norm; those organizations that do not make changes to upgrade their e-communication and e-record keeping systems will lose out to competitors.

Social Implications

Information is power. There will certainly be greater competition for information through nanotechnology. Once this technology begins to become perfected, then its applications and impact on society will be profound. The impact on human resources management functions and organizational leadership may be extraordinary – greater in scope than the endless applications of information flow on the internet. The applications may include engineering of enzymes, hormones, DNA, etc. Discoveries from nanotechnology will undoubtedly create new inroads into biotechnology and genetic engineering. Applications would profoundly improve the manufacturing and administration of prescription drugs.
The prospect of further dramatic extensions of our life expectancies raises questions of how an older population will be maintained. More people living longer may result in greater crowding, pollution, and food scarcity, unless advances in nanotechnolgy also improve food production and distribution. The almost unlimited power associated information nanotechnology will likely require strict governmental regulation and caution to minimum risks of unethical practices and unknown dangers to society.

Conclusion: Predicted Changes For HR & Organizational Leadership Professionals

Although still in the developmental stage, nanotechnology is close to reality as evidenced by the research funding it receives from the U.S. government, *e.g. *National Nanotechnology Initiative,* 2000. It is clear that nanotechnology will bring about many changes for organizations. For example, the already litigious prescription drug industry will experience more legal battles over new "nano-patents". New legal standards and reform legislation will likely cause change to employee healthcare benefits and participant rights. Other examples may include a greater demand for highly skilled workers with an expertise in the design and implementation of advanced intranet and internet technologies for employee communications, legal disclosures and benefits administration; Workers with molecular manufacturing expertise may also be in such high demand that they will likely be independent contractors for hire, much like IT professionals were in the 1990's.

Nanotechnology will let us make supercomputers that fit on the head of a pin, and fleets of medical nanorobots smaller than a human cell may enable elimination of cancer, cure infections, unclog arteries, and even significantly slow the aging process. These capabilities, and many other yet undiscovered capabilities, will undoubtedly challenge human resources management in helping organizations adapt to changes precipitated by nanotechnology.

HRM will be even more accountable as change agents and strategic partners, including – but not limited to - new responsibilities for recruitment of "nanotechno-specialists", redesign and implementation of new employee benefit plans, particularly health (medical, dental, vision), disability and retirement benefit plans, redesign and implementation new employee communication systems and legally mandated disclosures, and new education and training programs.

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