

Jason Alan Snyder  
Director, Technology and Strategy

SFGT  
2215 Walnut Street  
Philadelphia, PA 19103  
215.569.8600

February 10<sup>th</sup>, 2006

## **Personal Relationship Management – PeRM**

### **Who Will Answer the Call?**

"Longer term, the interest will be in finding ways to handle the communications of vital information from the home to medical professionals that know what to do with the information. Say you have a network of nurses that care for an aging individual. There is a need for them to periodically connect, as well as a need for frequently sharing health-care information among medical staff, family, and friends."

*-Gregory Abowd, associate professor at Georgia Institute of Technology's College of Computing*

The relationship between healthcare providers and consumers is changing quickly. Consumers continue to be able to bank, shop and communicate more and more easily. They can share any information or content – voice messages, music, pictures, and videos – with their friends and family from almost anywhere at any time.

Thanks to today's technology, consumers can join a wide array of synthetic communities where they can interact with people around the world and represent themselves in any way they see fit through avatars, usernames and the content they generate or seek out. From online communities such as Myspace.com, to fantasy football message boards and virtual communities like Second Life focused around totally immersive transactional marketplaces, consumers have more opportunities to express themselves – whether true or virtual – than they have ever had in history.

With this level of access to the people and things they care about, why is there a hole when it comes to health and nutrition—the very foundation of an individual's modern identity? Shouldn't there be a way for people to have meaningful interactions and discussions about their health and their nutrition in a trusted community—and, with the opportunity to transact?

As this freedom of choice and expression grows, coupled with the proliferation of portable technology, all industries will need to provide the same type of ease of access, sense of community and personal empowerment to all facets of life. J&J happens to be poised at every facet.

## **What's been going on for the last 40 years?**

Even while the proliferation of technology continues to amaze many people today, the impact that computers were initially purported to have on our daily lives and interactions with other people and social institutions has yet to really be fully realized.

On December 9, 1968 at 11:27 a.m. PST, Douglas C. Engelbart and the group of 17 researchers working with him in the Augmentation Research Center at Stanford Research Institute in Menlo Park, CA, presented a 90-minute live public demonstration of the online system, "NLS," they had been working on since 1962.

This event marked the public debut of the computer mouse and several other innovations, including hypertext, object addressing and dynamic file linking, as well as shared-screen collaboration involving two persons at different sites communicating over a network with audio and video interface.

### **Navigating Life**

As Engelbart put it, his NLS was an instrument for helping humans operate within the domain of complex information structures. By "operate", Engelbart meant compose, study and modify. And by "complex information structures", he said that content represents concepts, but there is also a relation between the content of concepts, their structure, and the structure of other domains of human thought that is too complex to investigate in linear text.

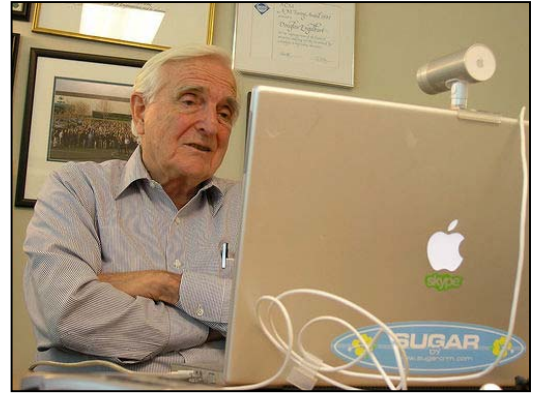
Engelbart went on to explain that the computer is a tool for navigating through those structures and examining them in ways that would be too complex otherwise.

Engelbart, who was awarded the National Medal of Technology in 2000 for creating the foundations of personal computing, is still working today pursuing his vision of far more powerful systems that would help people collaborate more effectively to solve the big problems -- many of which were complicated and speeded up by the technologies he helped launch.

"That's the big, big thing that's so important: How do we increase the capability of people to deal collectively with urgent complex problems? That's been my pursuit all these years," he told his hometown newspaper, *The Almanac*, in 2001.



Douglas Englebart - 1968



Douglas Englebart - 2006

Click Below – RealPlayer required ( <http://www.real.com> )

<pnm://vodreal.stanford.edu/Engel/05Engel200.rm>

<pnm://vodreal.stanford.edu/Engel/11Engel200.rm>

### **Where are we now?**

As I said at our Feb. 15, 2006 meeting in the board room at 601 Office Center, Customer Relationship Management is as close as we get to our concept of PeRM in today's world. For the sake of our discussion, let's say CRM entails all aspects of interaction a company has with its customer, whether it be sales or service related.

Over the last 15 years, consultants and businesses large and small have applauded CRM and its ability to establish a "corner store" environment. Suddenly they're able to get to know their customers like the corner grocery owners of yore once did, companies learned all they could about their customers needs, habits and financial capabilities and followed up with lots of communication.

But no matter how friendly the grocer, sometimes you just don't feel like talking - or listening. After a while, you might just find him annoying and wish he only spoke to you when you wanted him to and that he didn't ask the same questions time after time.

## CRM

We have all heard of CRM. Customer Relationship Management:

Infrastructure that enables an increase in customer value by including tools and tactics that motivate customers to remain loyal and continue transacting.

Generally, a collection of integrated applications, which facilitate the seamless coordination between the back office systems, the front office systems, and the web.

CRM is a great tool to increase usage occasions and to generate incremental profits.

Let's look at some of the practices and issues within CRM:

Corporate	Loyalty
Little or no choice for consumer	Focused on Most Valuable Customers
Programmatic	About the company
Vast	Companyspeak
Ceaseless mail, phone, email	No Timing

To put it simply, CRM=*Push*, and has little or no immediate value to consumers.

## Personal Relationship Management

While CRM entails all aspects of interaction a *company has with a customer*, Personal Relationship Management entails all aspects of interaction a *customer has with a company*.

Let us compare some of the practices and ideas with CRM and PeRM:

CRM	PeRM
Corporations	Consumers
Most Valuable Customers	Me
Vast	Individualized
Companyspeak	My terms
Loyal	Invested
Programmatic	Dynamic
Mail, Phone, Email	Digital (voice, video, images, text)

Why does PeRM have more value for consumers? It is "always on" and is always in the consumers' language. PeRM will be on the consumer's time, meeting his or her needs and dealing with the people the consumer wants to deal with. PeRM is all about the consumer.

Simply, PeRM = *Pull*.

Personal Relationship Management provides customers with branded, digital tools that can facilitate contact with the people and things they care about.

In the same way that corporations have employed complex technologies that track consumer preference, pattern and proclivity PeRM empowers those same consumers to utilize tools to manage the complex information landscape.

PeRM is about having the tools that connect nutrition with life style convenience and audience education.

### **Opportunities:**

The opportunities within PeRM are immense, especially when it comes to creating a life-long relationship with consumers through participation and engagement.

Other opportunities:

- Differentiate our products
- Facilitate compliance
- Create social currency
- Bridge the consumer and the HCP community
- Control the economics of the category

*There is plenty of information about food, exercise, medicine and personal relationship management that exists today. But there is no one resource, HCP or influencer that is bringing it all together for the consumer.*

We believe the consumer is seeking something that is integrated, personalized, responsive, dynamic and motivating.

**Integrated:** Food, Medicine, Energy and Vitality, and Relationships

**Personalized:** Meets individualized needs for the unhealthy, healthy, and HCP

**Responsive:** Adapts content and presentation to daily living

**Dynamic:** Embraces health status on an individual and group basis

**Motivating:** Builds and reinforces compliance for the individual

## **Lenses**

Consumers' "lenses" are human and professional. They are ever changing and not easily understood from statistics, purchasing patterns or customer service calls. For example:

- I am a woman running a marathon.
- I am a caregiver for a cancer patient.
- I am a family physician diagnosing an obese child.
- I am an executive delivering a speech to the American Diabetes Association.
- I am a chef preparing a meal for diabetics.
- I am a Viactiv user and need a hip replacement.

So what resource, HCP or influencer will be the most valuable as consumers continue to become more informed and empowered and force the healthcare industry to change?

- Someone that people seek out the most.
- Someone that interfaces with the most people possible.
- Someone that is always there for people 24/7.
- Someone that is totally dedicated to nutrition.
- Someone that can answer every person's nutritional questions and needs.
- Someone that endorses our products.
- Someone that works exclusively for us.
- Someone that customizes solutions around "my wellness."
- Someone that empowers the hero.

## **Amigo**

Amigo is a Personal Digital Healthcare Product that allows individuals to join or develop communities and networks of all sizes and within any demographic to gather, store, share, rate and comment on any kind of medical, health, food or nutrition information they can think of.

To use the language we have constructed, Amigo - at its essence - is a product that gives individuals the tools to empower their body by truly helping them manage the intersection of food, medicine, exercise, and Personal Relationship Management.

Some of Amigo's capabilities and the opportunities it will generate include:

- Filtering and managing audience- and partner-generated content.
- Contextually aware.
- Providing a branded environment, for all of your audiences.
- Spanning the entire product portfolio.
- Facilitating efficacy across J&J.
- Aligning with the idea of a "drop-in community."
- Establishing and promoting trust with McNeil Nutritionals.
- Invigorating trust in J&J.

Let's examine some of the questions around Amigo and what it can do:

### **Who wants Amigo?**

The call for more useful technology within healthcare is coming from everywhere; from grandmothers who want to be able to contact their doctor's about prescriptions and teenagers who want to eat right, to insurance companies looking to cut costs and the President of the United States, who is making a national electronic database of health records a focal point of his healthcare policy.

With the aging of the baby boomer generation and the childhood obesity issue growing in the U.S. – and its increase in countries such as India, France and even China – the need will continue to grow.

"With economic growth there is always a pattern of associated healthcare improvements as citizens demand better provisions," said Novartis Chairman and CEO Daniel Vasella at the company's recent annual meeting. "Economic prosperity is also accompanied with more sedentary work such as sitting behind computer screens. Children also start to play computer games rather than play soccer outside. This leads to obesity, hypertension and diabetes, which increases the need for medication."

Here is a short list of some of the people and organizations looking for technology to help them improve their physical or their fiscal health.

Consumers	Disease management programs
Corporations	Insurance companies
HCPs	Prescription benefit managers
SMEs	Medicare
Regulatory bodies	Medicaid
Industry groups	Competitors
School districts	Federal and state governments
Hospitals	Regional Health Information Organizations (RHIO)

### **What are the Consumer Benefits?**

The benefits are endless. Amigo can be as big or small as the consumer wants it to be.

- Expression of my identity.
- Language.
- Culture.
- Priorities.
- Helps me enjoy life to the fullest.
- Facilitates my decision making.
- Is proactive in providing relevant information, insights, ideas, and advice.
- Intuitive, easy to use.
- Real world, engaging and fun, not theoretical.
- Information and motivational experiences for me and the people I care about.

### **What is Amigo's value to the McNeil Nutritionals?**

- Bridge to the Influencers: product that HCPs can use and recommend
- Encourages a relationship between McNeil and payors
- Potential revenue stream: subscription and/or ecommerce, partnership opportunities
- Frees up market research budgets: Real people = real data
- Trial of new and future Nutritionals and J&J brands
- Social currency
- Cultural currency
- Differentiation: no one owns convergence and compliance in a meaningful way
- Causes compliance thru Empowering the Human Body
- Global
- In every language in the world
- Culturally relevant
- Anywhere digital can go
- Always on: 24 x 7 x 365
- Enhances credibility within the nutripharma/medical nutrition arena
- Empowers the individual to integrate our products and HCPs into his ideal
- Introduces incremental revenue opportunities

Helps drive habitual behavior and cause compliance:

Choice

Relevance

Integration

Convenience

### **Who provides the content for Amigo?**

Shaped by communities of real people.

Partners and consumers.

Healthcare Providers, experts, retailers.

Diabetics, pediatricians, moms, marathoners, etc.

J&J Properties.

### **What is audience-generated content?**

Everything from what I ate for lunch (complete with photos I took with my camera phone) to where I'm going on vacation.

Experiences are tuned as a direct result of people engagement.

Avataristic.

I:I.

A personal profile, or "bodyprint" of me, my family.

Biomarkers, genotype, phenotype, etc.

Collects, organizes and facilitates the management of "Bodyprints."

Evolves with content based on the collective audience input.

As number of "Bodyprints" grow, so does value of the product.

### **What will the partner-generated content entail?**

Partners — ranging from The American Cancer Society to Wal-Mart

Data

Articles

Video

Directories

Expert advice and ecommerce

J&J generates content

Lifescan

Baby

EES

Vistakon

## **How does Amigo become part of my life?**

Amigo recognizes my “lens.”

A “lens” is the filter for my personal content profile.

Amigo constructs an experience and serves up content based on single or multiple audience lens(es).

## **Where does Amigo live?**

Amigo is a lifestyle product. Life happens everywhere you are.

So Amigo is accessible anytime, anywhere.

At the office, from my desktop.

Doing errands, from my PDA.

At a friend’s house, from my mobile phone.

In the car, from my satellite radio.

In the rec room, from my gaming console.

In the living room, from my cable box and DVR.

In my pocketbook, from my dedicated handset.

## **Why must Amigo be dynamic?**

Moment-to-moment, my lens can change.

Now I’m caring for my dad’s chemo aftermath, tomorrow I’m dealing with my migraine.

Today I have 50 patients to see, tomorrow I’m hosting dinner for 20.

Now I want the kids to stop eating in front of the TV. Later I have to figure out what I should eat at a Chinese restaurant.

Today I think of myself as overweight. Tomorrow I am diagnosed with diabetes.

## **PeRM and Medical Nutrition—through Amigo**

Your audience is the content.

We have learned that wisdom comes from family and nontraditional medical referrals.

One in five online consumers are exposed to media created by other consumers that could influence their use of drugs and other medical products and services.

(According to [JupiterResearch](#))

## **Use Cases:**

### **Steve and his two sons left to their own devices for dinner**

Steve in Akron, Ohio has two sons – Mike and Tim – who just got out of football practice and they're all looking to get something healthy to eat since mom is at work and not cooking tonight.

Mike needs to lose some weight, while his brother Tim wants to put some weight on his thin frame for football. Dad looks like he's in good shape, but he knows his most recent blood work – his doctor emailed him the results through Amigo – showed that his cholesterol was high.

With a quick search from the Amigo on his desktop computer at home, Steve found a chain restaurant nearby that was rated highly by other members of the National Community of High School Athletes' Parents he joined through Amigo.

Once at the restaurant, Steve and his boys are able to quickly see what sections of the food pyramid their meals will cover using the Amigo they had on their mobile devices. They can also see how many calories and how much saturated fat and trans fat was in their menu selections since Amigo contained the restaurant's menu items.

All three of them are able to use Amigo on their cell phones to enter their meals into their "Bodyprint". The boys were also able to email and text message their full day's food journal to their football team's assistant coach, who is monitoring his players' nutrition during the season. Dad also used Amigo to send his daily food journal to the dietitian his doctor recommended for him.

The three of them had tasty and healthy meals and even brought a salad home for mom, who had texted all three of them simultaneously by sending out a family-wide message through the Amigo community they set up to keep tabs on one another's eating and to support each others nutrition goals.

## **Dr. Stone's community of Amigos**

Dr. Stone sees many patients – young and old – who are dealing with being overweight, and feeling the physical and emotional impact. He learned by doing some quick research on the Amigo he downloaded onto his PDA that people tend to lose more weight when they get support from others. So he and one of his nurses set up an Amigo community on his website and invited all of his patients to join.

After opting in, Dr. Stone's patients were able to use their Amigos to produce and share food experiences with each other. They also shared weight loss goals and inspirations, recipes, including pictures of the finished meals, and tips for eating out and cooking for families.

Dr. Stone was able to track his patient community's overall weight loss by setting up a counter on the Amigo that added up the total weight loss of all the patients that had joined. He could check in through his Amigo a few times a week to see how they were all doing as a group.

Each patient was able to send Dr. Stone and the rest of the community emails and post messages on a message board seeking help or guidance. Amigo also allowed them to set up RSS feeds that sent them news on nutrition and any other news that they thought would be helpful to them. They could then share those articles with the community and add their own commentary. They could also download Dr. Stone's podcast through their Amigo.

Individually, Dr. Stone had all of his patient's records uploaded through Amigo on his PDA. His nurses and physician's assistants used the offices' desktop Amigo to track patients' test results, appointments, medications, family medical histories and insurance information. Amigo also helped his nurses decipher the immense number of CRT codes for services Dr. Stone provides for all of his patients.

Dr. Stone's nurses were also able to use Amigo to generate as much revenue as possible for Dr. Stone's practice, since they could more easily bill for more services. His nurses could also use Amigo to compare the compensation rates of services that were similar, and use the CRT codes that would generate the most revenue for the practice.

After his patients lost several hundred pounds as a group, Dr. Stone's efforts with his weight loss community got him some press in his local paper. He also was able to grow his practice thanks to the savings Amigo provided with record keeping and appointment reminders and the extra revenue he and his nurses generated thanks to their ability to decipher the CRT coding system and reimbursements with Amigo.

## **All in the Family**

Jin and his wife Sun just had a baby. Only a few months earlier, Jin's elderly mother, Quay, moved in with them. Quay has to take many medications and supplements to deal with her several medical conditions: diabetes, high blood pressure and osteoporosis. She had to move in with them after she had a fall.

Jin and Sun invested in their Amigo during her pregnancy so Sun could keep tabs on her various doctors appointments and to get information on what she should be eating during the different stages of her pregnancy. She also sought out an online community of Chinese mothers to help her learn some shortcuts so she could still cook authentic Chinese food for her mother-in-law and the rest of the family without spending so much time in the kitchen.

Jin set up his Amigo on his Comcast digital cable box so that an onscreen message would alert his mother to take her pills during the day while she watched her Chinese language programs from the couch in the living room. Communicating in Chinese, Amigo also let Quay know which pill she needed to take. She could turn the alert off with just the TV remote, no special equipment was needed.

Amigo also let Jin and his mother communicate with her many doctors and nurses as she recuperated from her fall and dealt with managing all of her health conditions. They were able to use Amigo to send Quay's blood sugar readings directly to her doctor via Amigo.

Thanks to Amigo, Jin and Sun were also able to find some low-impact exercise programs for Quay to do at home that would help her rehabilitation and increase her muscular and skeletal strength, which is important when dealing with osteoporosis. They were able to find it via the onscreen Amigo, which searched all of the Comcast On Demand and broadband video offerings and found the exercise video.

## **Nutritionals and scientific pessimism**

Nutritionals' focus is on its science. Scientists are trained to be skeptical. They speak cautiously of their research goals.

They rarely speculate beyond the current generation of scientific pursuits.

This made sense when a generation of science and technology lasted longer than a human generation.

But it does not serve society's interests now that a generation of scientific progress comprises only a few years.

And, as a result, your constituents' expectations demand dialogue about innovations at an accelerated rate.

## **The challenge**

So how are tomorrows accelerated innovations translated into audience value?

By providing our audience with branded tools that will allow them to manage the aspects of their lives the innovations touch.

Let's start by examining the medium landscape.

## **Today's Medium Landscape**

We have a complex media landscape with information everywhere.

Largely, media models have been a *push* out to medium receptacles.

Taking large amounts of data (or content), and *pushing* them out to audiences over a variety of platforms.

Print, Radio, Flexible Video, Direct, Web, E-mail, Wireless, etc.

## **Today's Medium Opportunity**

Industries have been built around the development of devices that help audiences consume and collect content *pushed* at them.

Web browsers, DVR's iTunes, Tivo, RSS, WindowsMedia Player, Real, etc.

Corporations in turn manage their *push* barrage and it's value to audiences by using CRM.

### **What about your audience?**

Your audience needs a way to connect the innovations, products and your content to their lives.

We should provide them with an opportunity to facilitate relevance.

A tool set that will *qualify* not just quantify the vast amount of data in their nutritional health environment.

## The Future

In the beginning of this piece we introduced several ideas, including those of Douglas Engelbart and the exponential growth of technology. We also discussed how these ideas will impact things such as healthcare and personal relationships.

Now I want to present to you a sketch of what is to come in the near-term future. We have heard a lot of broad ideas about the future, from analysts and consultants' future about trends and the rate of innovation to come.

Let's take a few moments to highlight some ideas inside of the macro observations that have been discussed.

### Technology Growth

In our discussions to date we have been measuring human progress with the assumption that technology growth is linear.

But have you considered an *exponential* model as it relates to technology?

### Internet

Here are some recent statistics on Internet penetration around the world from [www.internetworldstats.com](http://www.internetworldstats.com):

World Regions	Pop. (2006 est.)	Pop. % of World	Internet Usage (Dec. '05)	% Pop. (Penetration)	Usage % of World	Usage Growth 2000-2005
Asia	3.67 B	56.4	364 M	9.9	35.7	219 %
Europe	807 M	12.4	290 M	35.9	28.5	176 %
North America	331 M	5.1	226 M	68	22.2	109 %
Latin America/Caribbean	554 M	8.5	79 M	14.3	7.8	337 %

\*Globally, broadband connections grew by 24 percent last year and now make up 62 percent of primary Internet connections, according to Ipsos-Insight's annual "Face of the Web" survey.

### Cell phones

There are nearly **2 billion** mobile phone subscribers worldwide.

Of that 2 billion, nearly **195 million** are in the US, reports CTIA-The Wireless Association.

By 2009 it is predicted that there will be **240 million** mobile subscribers in the U.S., a penetration rate of **78.4** percent.

## Exponential Growth

Technology expands by repeatedly *multiplying* by a constant, *not by adding* a constant.

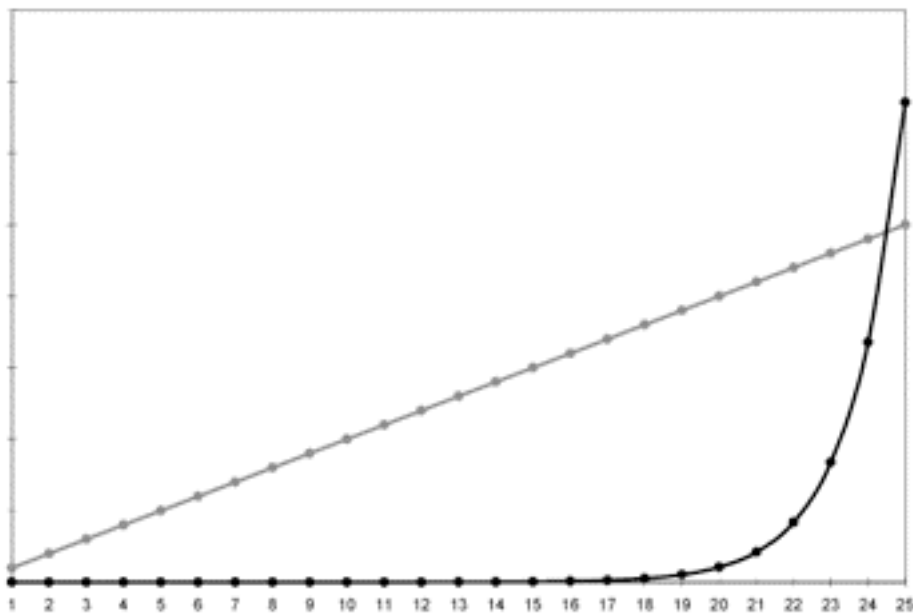
My father was a tax attorney. When I was little he explained this idea to me by challenging me with this proposition;

"Suppose you had a job for 60 days. Would you rather be paid \$100 per day, or be paid one penny the first day, and then double your money every day thereafter— as in, two pennies the second day, four pennies the third day and so on...?"

### Take the pennies kid...

With pennies - in 60 days you would have \$10,737,418.24 as opposed to \$6,000.00

### Linear vs. Exponential Growth



The core concept here is that linear growth is steady.

Exponential growth is explosive.

Most futurist forecasts dramatically underestimate the power and impact of technology developments because of a linear mindset.

As a result, with the common linear view the future is widely misunderstood.

## **Underestimating growth**

1000 years ago there were exponential trends.

But they were in such an early stage and so slow that they appeared like no trend at all.

Today, we expect continuous technological progress and massive social repercussions to follow.

If you think of the future this way it will surprise you dramatically.

It is difficult to internalize the implications of the acceleration of the rate of change itself.

The rate of acceleration will be staggering.

And, the repercussions will be nearly in parity with progress.

## **James Watson and fat people**

If you believe this, you're not alone. This linear view of technological progress is common.

About 35 months ago, in 2003, we celebrated the 50th anniversary of discovery of the DNA structure.

Time Magazine sponsored a conference called "*The Future of Life*" and asked all the speakers to talk about what the next 50 years will bring.



James Watson (in the yellow sweater above), the co-discoverer of DNA said:

"...in fifty years we will have drugs that will allow us to eat as much as we want without gaining an ounce."

However...

### **50 years just got a lot shorter**

We have already accomplished this in mice by blocking the fat insulin receptor that controls storage of fat cells.

Drugs for human use using RNA interference are in development and will be going for FDA testing around 2010.

These technologies will be available in about ten years. Not fifty.

### **Fast got faster**

The 20th century was speeding up to today's rate of progress.

The last 100 years of human technological achievements are equivalent to about 20 years of progress (at the rate progress in year 2000 terms).

We'll make another twenty years of progress in just fourteen years (by 2015).

And then, do the same again in another seven years (2022).

### **How fast is fast?**

We won't experience 100 years of technological advance in the 21st century.

Measured by today's rate, it will be more in the order of twenty thousand (20,000) years of progress.

Rather, technology progress that is near 1000 times greater than what was achieved in the 20th century.

### **Technology trends and the global economy**

We learned from our colleagues at HenleyCenterHeadlightVision, there will be a shift in the balance of global economics in the coming decades.

So let's consider specific wealth transformations resulting from a single technology trend.

For example: Radical life extension

### **“First we build the tools, then they build us.” - Marshall McLuhan**

What's the transformative result from radical life extension?

Radical wealth creation stemming from the areas of Nanotechnology and strong Artificial Intelligence (AI)

In the mid-2020's, nanotechnology-based manufacturing devices will be capable of creating almost any physical product from inexpensive raw materials and information.

### **The myopic challenge**

Many of us have first hand experience with the pace of change increasing over time.

Yet, our intuition leaves us with the impression that change occurs at the same rate that we have experienced most recently.

Math explains this phenomenon:

An exponential curve looks like a straight line when examined over a brief duration.

It is very easy to get entangled in the difficulties and intricate details of challenges Nutritionals faces today.

We need appreciate the ultimate long-term implications of the work Nutritionals is doing today.

We cannot overestimate what will be accomplished in the short term and we cannot underestimate the long term.

## **APPENDIX:**

### **The Giant, Staggering, Mind Bending, Compendium of SFGT's Technology Prognosticating**

Below are some notions we predict will have tremendous impact us in the near and long term as the future unfolds:

- The rate of technical innovation is accelerating. Doubling every decade.
- The power (price-performance, speed, capacity, and bandwidth) of information technologies is growing exponentially faster. This principle applies to everything including human knowledge.
- For information technologies, there is a second level of exponential growth: exponential growth in the rate of exponential growth (the exponent). As technology becomes more cost effective, more resources are deployed towards its advancement, so the rate of exponential growth increases over time. In the 1940's the computer industry consisted of a handful of projects. Today the total revenue in the computer industry is over one trillion dollars so R&D budgets are considerably higher.
- Human brain scanning. The temporal and spatial resolution and bandwidth of brain scanning are doubling each year. We are now just developing tools to begin meaningful reverse engineering (decoding) of the human brain's principles of operation. Today we have models and simulations of 24 or so of the several hundred regions of our brain. Within 20 years we will have a detailed understanding of all the regions of the human brain.
- We will develop the requisite hardware to emulate human intelligence with supercomputers by the end of this decade and with personal computer sized devices by the end of the next decade. By the mid 2020's we will have software models of human intelligence.

### **The Turing Test**

- With both the hardware and software needed to fully emulate human intelligence, we can expect computers to pass the "Turing Test" (a challenge to indicate intelligence indistinguishable from biological humans) by the end of the 2020's.
- When computers pass the Turing Test we will be able to combine the traditional strengths of human intelligence with machine intelligence
- One of the biggest strengths of human intelligence is the ability to recognize

patterns. The massive, parallel and self-organizing nature of the human brain is an ideal architecture for recognizing patterns that are based on subtle invariant properties. Humans are also capable of learning new knowledge by applying insights and inferring principles from experience, including information gathered through language. A key capability of human intelligence is the ability to create mental models of reality and determine models for "what-if" outcomes by varying aspects of these models.

- The traditional strengths of machine intelligence include the ability to remember billions of facts and recall them instantly.

## **Speed**

- Another advantage of non-biological intelligence is that once a skill is mastered it can be performed repeatedly at a high-speed, at optimal accuracy without tiring.
- Machines can share their knowledge at extremely high speeds compared to the slow speed of human knowledge sharing through language.
- Non-biological intelligence will be able to download skills and knowledge from other machines and also, one day, humans.
- Machines will process and switch signals at close to the speed of light (300 million meters per second), compared to 100 million meters per second for the electrochemical signals used in biological mammalian brains. This speed ratio is about 3 million to one.

## **Nanotechnology**

- Along with the accelerating improvement cycle of non-biological intelligence, nanotechnology will enable the manipulation of physical reality at a molecular level.
- Nanotechnology will enable the design of "nanobots" (robots designed at a molecular level). The machines will be measured in microns such as the "respirocytes" (mechanical red blood cells) we have designed today. Nanobots will have many jobs in the human body such as reversing the human aging process.
- Nanobots will interact with biological neurons to vastly extend human experience by developing synthetic reality from within the nervous system.

- Billions of nanobots in capillaries of the brain will also vastly extend human intelligence. Nanobots will also enhance the environment by reversing the effects of pollution.

### **Virtual reality**

- Nanobots that can manipulate image and sound waves will bring synthetic reality to the real world.
- As virtual reality derived from the nervous system begins to compete with real reality in terms of resolution and believability our experiences will increasingly take place in synthetic environments.
- In synthetic reality we can be a different person both physically and emotionally. In fact, other people will be able to select a different body for you than you may select for yourself. Of course, the converse will be true as well.

### **The Law of accelerating returns**

- The law of accelerating returns will continue until non-biological intelligence comes close to enveloping the matter and energy in our vicinity of the universe with human-machine intelligence. Human-machine intelligence will use matter and energy patterns in such a way as to optimize our world space such as we understand the physics of computation. As we approach this limit the intelligence of our civilization will continue its expansion by spreading outward towards the rest of the universe.
- The speed of our universal expansion will be in parity with speed at which information can travel.
- Ultimately, the entire universe will become saturated with our intelligence. We will determine our own fate rather than have it determined by the forces that rule celestial mechanics.
- The length of time it will take the universe to become intelligent will depend on whether or not the speed of light is an immutable limit. The vast intelligence in our future will be able to determine if these exploits are possible.