Intellectual Capital Management

24 Hours Take Home Exam

Please read the following instructions carefully:

1. You may freely brainstorm and discuss the exam questions with your colleagues.
2. Your answer should be written individually and independently.
3. No further research on Roche is required.
4. Type your answer with 1.5 lines spaces.
5. Use your exam number.
6. You may use the grades for each question to determine the amount of material required. Your answer for any single question should not exceed six pages.

Good Luck

QUESTIONS

> *"The only way to embrace a technological revolution (biotech), Roche has discovered is to unleash an organizational revolution" (paragraph 9 of the attached article).*

You have been retained by Roche's CEO to guide this 'organizational revolution'. Present a report to the CEO suggesting ways for Roche to deal with the following issues:

Question One (15% of grade)
Outline in the introduction of the report what is intellectual capital management including a definition of what each of the stages of knowledge management, innovation management and intellectual property management entails. In your answer, include the types of intangible assets that Roche should manage under each stage.

Question Two (15% of grade)
Describe the culture that Roche needs to create and encourage to effectively implement intellectual capital management programs. Where does Roche stand now (at the time of the article) as to its culture and what do you propose Roche should do to effectively transform the culture to one that fosters knowledge sharing and employee-initiated innovation. In your answer, refer to the sidebar section.

Question Three (35% of grade)
The real challenge that Roche faces is not data and information management but rather "shunting all of that information into the scientists' brains and making sure that they can process it well", (paragraph 14 of the article). Though 'knowledge management' has started in Roche with the 'corridor meetings' and collaboration between oncology and genomics, a systemized approach is required for Roche to effectively manage its tacit and explicit knowledge resources. Outline the knowledge management strategies, practices and tools that Roche should implement to face this challenge. In your advice, address the types of audits that Roche should undertake, and the structural changes required.

Question Four (35% of grade)
"... [T]he genomics revolution is incredibly jarring as well. In fact, reckoning with the its impact demands a fresh start in the fundamentals of innovation and R&D ....", (paragraph 6 of the article). Outline the changes that took place in Roche innovation and R&D structure so far to respond to the 'genomics revolution'. Recommend steps that Roche should take to better manage its innovation portfolio. In your answer refer to the stage gate method among other solutions.

Fresh Start 2002: Roche's New Scientific Method
By George Anders
Fast Company issue 54, page 60

How does a giant pharmaceutical company reckon with genomics technology? By making a fresh start in how it recruits its scientists, manages projects, and uses computers. Here's how the Roche Group is reinventing how it invents.

Four years ago, Holly Hilton was training to be a fruit-fly and plant geneticist. She had completed her PhD at Rutgers in 1996, and she had an academic career in store. But she was itching for excitement. A revolution was taking shape in human genomics, and her worry was, "I'm missing it."

Just then, the Roche Group was having its own epiphany. For years, the Swiss pharmaceutical giant pitted veteran scientific teams against one another. That proud, stubborn culture helped Roche develop blockbuster drugs such as Valium and Librium. But it wasn't working anymore. For Roche to move forward, the company needed to wipe away its gladiator mentality and replace it with a warmer style of teamwork -- especially in the chaotic, booming new field of genomics.

So Roche began running ads in the back pages of Science magazine, looking for a new breed of researcher. It wasn't essential to have a glittering, 20-year resume. Roche wanted people who were starting out, who could reinvent themselves as job opportunities changed. When Hilton saw one of those ads, she sent in her resume and told herself, "I want that job."

Today, Hilton is on the front lines of Roche's push into the genomics era. She runs a bustling lab at Roche's U.S. pharmaceuticals headquarters in Nutley, New Jersey. In a workspace the size of a galley kitchen, she and three assistants load up $100,000 machines with tiny samples of cryogenically preserved tissue. Each time the machines whiz into action, researchers pry out more secrets of the samples' DNA.

For Roche, these are thrilling times. Week by week, new breakthroughs in genomics and molecular biology are upending the way it hunts for new drugs. It's now possible to pursue new drug targets with a speed and gusto that would have been unimaginable a few years ago. It's possible to size up toxicity risks earlier than ever. And it's becoming possible to match up drugs with the people who are best suited for them, ushering in an era of customized medicines.

But the genomics revolution is incredibly jarring as well. In fact, reckoning with its impact demands a fresh start in the fundamentals of innovation and R&D. Old ways of managing projects don't make sense. Roche can now run 1 million genomics experiments a day, churning out enough data to overwhelm every computer it owns. Research teams that once spent years looking for a single good idea now face hundreds or even thousands of candidates. Without a clear way to handle all of this information, it's possible to drown in the data.

"There's a huge amount of ignorance and hype," warns Jonathan Knowles, Roche's global head of research. Yes, knowing the human genome in detail can generate thousands of exciting possibilities for new-drug development. "But it costs $50 million or more to find out if each one is viable," he explains. "And most of them don't pan out. Getting a new drug all the way through the pipeline is a tremendously complicated process. Before we can commit to those kinds of projects, we need to know much more about the odds for each one."

Still, at the highest levels of Roche, there is real excitement about what lies ahead. At a media briefing last August, Roche Group chairman and CEO Franz Humer declared, "Look at this revolution of genetics, genomics, and proteomics. It's becoming ever clearer that we will be able to identify early the predisposition of people to disease -- and to monitor and treat them more effectively. We'll develop markers for cancer. That will lead to better test kits and to new pharmaceuticals."

So what is the right way to reconfigure a company when breakthrough technology shows up on its doorstep? Step inside Roche's U.S. pharmaceuticals headquarters, and you'll see how that adjustment is

taking place. It begins with something as basic -- and hard -- as embracing the excitement of having way too much data, too fast. It goes on to include new thinking about the best ways to build teams, hire people, and create a culture where failure is all right, as long as you fail fast. The only way to embrace a technological revolution, Roche has discovered, is to unleash an organizational revolution.

Finally, Roche is nudging this upheaval systematically, one piece at a time. Some parts of the company, such as basic research, have been utterly transformed by genomics. Other areas, such as animal studies and patient trials of experimental medicines, are feeling the first stirrings of new techniques. Not everything needs to be ripped up and rebuilt at once. Over time, though, every aspect of health care will be transformed.

Learning to Swim in a Deluge of Data

In the genomics explosion, think of the GeneChip as the detonator. To the unaided eye, it is merely a carefully mounted piece of darkened glass, barely bigger than your thumbnail. Look closely, though, and you can see countless tiny markings on that glass. Each mark represents the essence of a human gene -- assembled one amino acid at a time on to the glass. All told, there may be as many as 12,000 different genes on a single chip.

Drug companies have been showering the GeneChip's inventor, Affymetrix Inc., with big orders since the chip first hit the market in a meaningful way in 1996, and it's easy to see why. Run the right experiments, and the GeneChip will light up the specific genes that are activated in a medically interesting tissue sample. Suddenly, hundreds of brilliant white and blue dots burst forth against the chip's dark background, like the Arizona desert sky at night. It is an awesome sight. Each time a chip lights up, you behold a glimpse of which genes might be markers for disease. Yet for all of the ingenuity involved in making the GeneChip, it has required cleverness on Roche's part to use the chips effectively within a big organization.

Take something as basic as computer capacity. Each sample run on a GeneChip set generates 60 million bytes of raw data. Analyze that data a bit, and you need another 180 million bytes of computer storage. Run 1,000 GeneChip experiments a year, which Roche did in both 1999 and 2000, and pretty soon you run the risk of collapsing your data systems. "Every six months, the IT guys would come to us and say, 'You've used up all of your storage,' " recalls Jiayi Ding, a Roche scientist. Some of those encounters were outright testy. At one point in early 1999, Roche's computer-services experts pointed out that they were supposed to support 300 researchers in Nutley -- and that the 10 people working on GeneChips were hogging 90% of the company's total computer capacity.

Dealing with the computers has been the easy part. A bigger challenge involves shunting all of that information into scientists' brains -- and making sure that they can process it well. "We used to look at several data points for each experiment," says Louis Renzetti, senior director of discovery pharmacology. "Now there are dozens and dozens." Simply dump all of that data on a scientist's desk, and one of two tragicomic things will happen: Either the scientist will want to pursue every promising lead and will end up like a frazzled amusement-park visitor, or the scientists will refuse to touch the report at all, for fear that she will never be able to make sense of it.

It has taken a while to find the right approach, says James Rosinski, one of Roche's experts in the new field of bioinformatics, which covers the management of genomic data. The key, he says, is for biologists and statisticians to start talking early about how to use data from a GeneChip experiment. "It's iterative," he explains. "We can't just take a one-shot approach and tell the biologists what they ought to be interested in. We have to interact." That way, researchers from different disciplines can gradually make sense of a giant stack of printouts, turning it into a shortlist of the best prospects.

Sometimes the smartest thing is knowing when not to run a GeneChip analysis. "Back when we were working on one gene, we could do fishing experiments," recalls a Roche researcher. "When you get data from 12,000 genes, you need to be careful about setting up experiments. You'll get data. If it isn't useful, you can waste a lot of time looking at it."

Turbulent Times Demand Flexible Teams

Most of the time, cancer researcher Barry Goggin does his best work either at his desk or inside one of Roche's laboratories. But in the summer of 1999, he noticed a switch in his work practices. "We started having corridor meetings," he recalls. "We would just start talking. It might be a couple of us from oncology and then a person from genomics. Back then, there wasn't any official way for us to work together. So we'd just get together in the corridors and design all sorts of small projects."

A bureaucratic boss might have told the researchers to stop gossiping and get back to the lab. But Roche's head of preclinical research at the Nutley headquarters, Lee Babiss, liked what he saw. In fact, he wanted to cut across traditional departmental boundaries and create interdisciplinary teams. That way, Roche could harness the energy of those corridor meetings and try to direct it toward breakthrough science.

In October 1999, Roche formed the Genomics Oncology (GO) team -- an ad hoc combination of seven Nutley researchers from the genetics and oncology departments. It was one of the most eclectic teams Roche had ever assembled. Team members had backgrounds in areas from immunology to statistics. They were born in countries as far from each other as China and Germany. But they were united by a desire to identify new targets for cancer drugs using the GeneChip and other genomics tools.

Leading the GO team was Juergen Hammer, a vivacious German-born genomics expert. He had been chafed by the fact that his department was producing all of this exciting data, but no one else at Roche was able to look at it. Now he had his chance. His mandate: to focus on colon cancer, a disease that was common and well understood on a molecular level, but that still was not being treated very effectively with existing drugs.

Hammer's approach involved a blizzard of GeneChip experiments that were designed to show which genes might be linked to colon cancer. "You let the data speak," he explains. "That's the genomics paradigm." The oncologists were intrigued -- but they were much more comfortable with a classic review of scientific literature and molecular structure, where they would try to identify targets with the best potential for effective drug interaction. "It was almost as if two different languages were being spoken by the geneticists and the oncologists," Goggin recalls. "We had to bridge the gap."

Gradually, team members found ways to make the most of one another's specialties. When data analysis grew numbingly complex, the GO team recruited James Rosinski, who joined the team and helped colleagues unravel the numbers. From the early GeneChip experiments, more than 100 genes were identified as being potentially associated with colon cancer. Some of those genes also turned out to be critical for normal heart or kidney function. They were rapidly discarded. All through 2001, the list of promising candidates grew steadily narrower.

Eventually, two targets, which were endorsed by senior management, were selected. Intriguingly, both of the first two selections had been among the 50 most promising prospects in those early GeneChip experiments. But neither had been among the top 10. By combining genomics and oncology techniques, researchers had isolated new drug targets that would have been overlooked by either set of specialists working alone.

Hire Young Researchers for a Young Field

Ask Holly Hilton about her PhD research before she joined Roche, and she offers a wry smile. "It took me six years to gather all the data," she says. "We were making our gels by hand back then. Now you could probably run all of my experiments in two months. And at the time, we thought that we were so cutting edge."

In most fields, you don't hear that kind of reminiscing until people are in their fifties or sixties. But everything associated with the human genome is moving at a breakneck pace. Research techniques that seemed breathtakingly sophisticated in the mid-1990s are now as quaint and outdated as computer punch cards or hand-cranked automobile engines. As a result, researchers who are in their mid-thirties, such as Hilton, aren't viewed as apprentices who must still finish their hands-on training. They are regarded as fully formed experts in their field.

"This is such a fast moving field," says Klaus Lindpaintner, Roche's worldwide head of genetics research. "We're doing molecular biology now with equipment that we couldn't have dreamed of having 10 years ago. I'm not sure that it really helps you to have started your career in the era when you had to distill your own compounds. A young researcher can be fully up to speed with the most modern stuff and be less distracted by all of the other things that 50-year-olds focus on."

In her own lab, Hilton supervises a 27-year-old scientist, Nishi Sinha; a 38-year-old colleague, Mark Walstead; and an assistant who is in her late twenties. The four of them swing into action immediately after GeneChip experiments, running what is known as a single-tissue expression profiling (STEP) lab. Their mission: to run fresh tests that help narrow down the GeneChip experiments' enormous list of candidates.

Each time a GeneChip researcher thinks that she has found something promising, Hilton and her team assess its behavior in as many as 200 different tissue samples. They check to see if that gene is especially active in a healthy liver, heart, pancreas, or in other organs. They investigate whether it behaves differently in cancerous cells -- and, if so, whether that behavior varies depending on the type or stage of cancer.

By the time they are done, it's a lot clearer whether a gene's impact is narrow or broad. That's a crucial distinction. Genes that are associated with cancer and little else can make promising targets for new pharmaceuticals. But if a gene touches many aspects of life, it almost certainly would be futile to try to disrupt its function with a new drug.

These days, Hilton's STEP lab is a precision machine, running just the way Roche wants it. Hilton has about 10 other researchers' projects that will be ready for her lab's attention soon, but they all have scheduled start dates, and no one is complaining about delays. New equipment added last year lets Hilton analyze 96 samples at a time, up from just a handful at a time when she started.

When Hilton joined Roche in 1998, the STEP lab didn't exist in any form, and building it was a matter of constant improvisation. "No one was an expert in genomics then," she recalls. In early 2002, Hilton almost certainly will upgrade her neatly constructed STEP lab with more-advanced equipment that can handle 384 samples at a time. That's progress.

"You need people who have the agility to handle change," Hilton observes. "I haven't been doing this for 20 years. By the traditional definition, I'm not an expert. But I'm very comfortable being a team player. I'm not wedded to the idea that we have to do things the way we've always done them. I'm willing to try something new. And that's important."

Fail Fast, so You Can Succeed Sooner

One of the biggest challenges in drug research -- or in any field -- is letting go of a once-promising idea that just isn't working anymore. Without strict cutoff rules, months and even years can slip away as everyone labors to keep a doomed project from dying. Meanwhile, much brighter prospects sit dormant, with no one able to give them any attention.

Roche went outside its ranks to hire Lee Babiss as the new head of preclinical research at Nutley headquarters. Babiss arrived from arch rival Glaxo with a simple message: Fail fast. Babiss wanted successes as much as anyone. But he also knew that the best hope of finding the right new drugs involved cutting down the time spent looking at the wrong alternatives.

Four years later, Babiss's doctrine of failing fast has spread throughout Roche's U.S. labs. "It's a numbers game," explains Philip Familletti, a Roche research manager. "To identify 2 targets as clinical candidates that deserve further development, you need 18 to go in for review. The further you go with development, the more it costs. And once you start clinical trials with patients, the cost is outrageous."

This sifting process has become more vital than ever, now that Roche's genomics teams are finding a flurry of unexpected new drug targets. A few of those targets will turn out to be breakthroughs, if Roche can come up with a molecule that will jump into a specific target and change biological pathways in a manner

that will help patients. Many others will turn out to be dead ends, where there just won't be any way to get a potential drug locked into that target -- or where the only molecules that will fit will ultimately be harmful to patients.

The only way to know for sure about these targets is to start screening molecules, one by one. At most big drug companies, that means working through a "library" of 500,000 to more than 1 million possible compounds. The only way to know if compound 337,194 might work is to try it. If that's a dud, it's time to move on to compound 337,195.

At one point, Famillетti delicately explains, "screening was becoming a bottleneck for us." But not anymore. At locations around the world, including Nutley, Roche has installed an ultra-high-throughput screening system made by Carl Zeiss of Germany. It is an enormous four-part robot with conveyor belts and work stations where trays jammed with 1,536 samples apiece are analyzed. The cost: more than $1 million.

"We can test 100,000 compounds a day," says Larnie Myer, the technical robotics expert who keeps the Zeiss system at Roche running. Nearly all of those compounds will turn out to be useless for the mission at hand. But that's fine. If his team can get the losers out of consideration for that trial in a hurry and identify a handful of "hits" within a few weeks of testing, that speeds Roche's overall efforts.

What's more, the Zeiss machine represents the gradual retooling of Roche's overall research efforts. Thanks to advances in genomics and molecular biology, the beginning of the research cycle is packed with an enormous outpouring of possibilities. That surge is starting to flow through everything else that Roche does. Processes farther down the pipeline must be upgraded and reworked in order to handle much greater volume. That is hard and disruptive work -- but it is vital.

Change Everything -- One Piece at a Time

Peek into almost any aspect of Roche's business, and you will find someone who is excited about the ways that genomics could change things. In Palo Alto, researcher Gary Peltz has built a computerized model of the mouse genome that allows him to simulate classical lab studies in a matter of minutes.

In Iceland, Roche is teaming with a company called Decode, which researches genealogical records from the Icelandic population. That data has helped Decode identify and locate genes that are associated with stroke as well as schizophrenia and other diseases, giving Roche new research leads that otherwise might never have surfaced with such clarity.

In South San Francisco, California, Genentech Inc. (whose shares are owned mostly by Roche) is marketing Herceptin, a new drug to fight breast cancer that is targeted at the 25% to 30% of breast-cancer patients who have a specific genetic malfunction. A few years ago, there would have been no way of knowing which women were best suited to treatment with Herceptin -- and the drug might never have made it out of clinical trials. Now, though, advanced genetic testing makes it possible to target the right patients -- and avoid months of futile treatment for everyone else.

And in Nutley, there is talk that genomic data will make it possible to size up a drug's side effects with much greater clarity before embarking on lengthy animal experiments. It will be possible to run simulations or GeneChip experiments with potential new drugs to find out whether they might interact in troublesome ways with the functioning of healthy genes.

Finally, genomics will lead to new diagnostic tools that will make it much easier for doctors to size up patients' health and predisposition to disease. That's especially intriguing for Roche, which has a big diagnostics business in Europe and the United States. Traditionally, Roche's diagnostics and pharmaceutical businesses haven't interacted much, but a shared interest in genomics makes for greater collaboration ahead.

Each of those initiatives is running on a different timeline. Some parts of Roche's business will be aggressively reshaped in the next year or two; others may take five years or more to feel the full effects of

the most recent genomics breakthroughs. "This isn't just a matter of turning on a light switch," says Klaus Lindpaintner, Roche's global head of genetics research.

Yet eventually, Roche executives believe, all of the retooling within their company will be mirrored by even bigger changes in the ways that all of us get our medical care.

"Diagnosis and treatment will come ever closer," Roche's CEO, Franz Humer, predicts. "We're already seeing that with Herceptin for breast cancer. Before long, we'll see it with high cholesterol or osteoporosis." Or, as Roche's research chief, Jonathan Knowles, puts it, "The future will be all about rational prescribing. We'll finally know exactly what medicines to give to exactly which people."

Sidebar: Roche's Big Discovery: Teamwork

A huge green T-shirt stretches across the wall of Joseph Grippo's office, with the word "Glucogen" written alongside a picture of a sugar-maple tree. It looks like a souvenir of a long-ago pep rally. No wonder: It is indeed a relic of a different era.

In the mid-1990s, research scientists at Roche were divided into competing teams -- with a mandate to fight one another for resources. Teams took on names that were medically interesting or outright heroic. Glucogen jostled against Camelot, Tsunami, and other rivals.

"There was a great burst of energy at first," Grippo recalls. "Teams made banners and worked late into the night." But as Roche's internal wars stretched on, the ultracompetitive approach became less appealing. Faltering projects became almost impossible to abandon, because scientists' careers were so wrapped up in them. Researchers were tempted to hoard technical expertise they picked up along the way, since sharing might allow others to catch up.

Finally, Roche disbanded its intramural competition in 1998, in favor of a more collaborative approach. "If you have just a few drug-discovery targets," says Nader Fotouhi, a vice president for discovery chemistry, "the competing-team approach can work. But if you have a large number of targets, it can't work."

In Roche's New Jersey GeneChip lab, researcher Hongjin Bian has won worldwide acclaim during the past three years for developing savvy ways of handling the chips and reading the results. She has been encouraged to share her techniques with Roche colleagues as far away as Europe and Japan. With the old system, her insights might well have been kept secret