MEETING THE GLOBAL CHALLENGE THROUGH DIVERSITY

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By

Albert J. Simone
President

Rochester Institute of Technology

Table of Contents

	Page
INTRODUCTION	**1**
THE GLOBAL CHALLENGE	**1**
The World is Flat	**1**
Tatung Institute of Technology	**2**
International and Individual Financial Accounts	**2**
Misery Index	**3**
Key Component to Meeting the Challenge	**4**
EDUCATION: WE SEE THE ENEMY – IT IS US	**4**
International Comparisons	**4**
New York State and the Nation	**5**
MATH WILL ROCK YOUR WORLD	**6**
MEETING THE CHALLENGE THROUGH DIVERSITY	**7**
PROGRESS TOWARDS A SOLUTION	**10**
CONCLUSION	**12**

INTRODUCTION

In what follows, we shall describe some of the key challenges facing the United States at this time. We shall cite some general macro economic statistics which describe the U.S. economy over time and in relationship to other countries. The economic challenges we cite are cause for alarm.

We shall also speak to some of the data which describe the general status of education – at the K through 12 and university levels – in this country. Again, there is a significant case for alarm.

The economic discussion points to a problem that threatens our quality of life, standard of living, and, ultimately, even our democracy. The discussion around education is important because, as I shall argue in a later section of this paper, it is the key to meeting the challenge.

The solution, however, is not just to have more people better educated in particular disciplines. Rather, it is creating a system and changing the culture so that a particular segment of our population – namely, women and minorities (especially women) – become more fully engaged in specific academic disciplines which lead to expertise in particular professions.

THE GLOBAL CHALLENGE

The World is Flat

Thomas L. Friedman, in his recent book *The World is Flat*, describes some challenging and worrisome global activities:

- In 2005, 400,000 American IRS tax returns were prepared in India.
- Indian and Israeli firms are transmitting CAT scans via the Internet to the United States so Americans can get a second opinion from an Indian or Israeli doctor more quickly and cheaply.
- Indian engineers can handle most technical jobs at 1/10 the cost of American engineers.
- Wal-Mart last year imported $18 billion of goods from 5000 Chinese suppliers (who represent 80% of Wal-Mart's suppliers).
- For American automobile makers, health benefits cost $6,000 per worker if the car is manufactured in the United States. If it is manufactured in Canada, because Canada provides socialized medicine, the cost per worker is $800.

These examples and others that can be readily added, certainly give us pause for thought.

Tatung Institute of Technology

Twenty years ago, I visited, several times, Tatung Institute of Technology (TIT) in Taiwan. There are many interesting similarities between TIT and Rochester Institute of Technology (RIT). For example, TIT has a totally integrated co-op program. A thriving electronics company, Tatung Industries, has its manufacturing facility right next door to TIT. TIT students work as co-op students at Tatung Industries prior to graduating. After graduation, many of them go to work directly for Tatung Industries.

However, my point in describing TIT is not because it is an institute of technology like RIT, nor because like RIT it has a co-op program. Rather, my point is something very different. Every engineer at TIT is required to be fluent – in terms of reading, writing, and speaking – in four languages: Chinese, English, Japanese, and (at the time) Russian. They also are expected to be reasonably fluent in one other language which, typically, was selected from among German, French, Italian, and Spanish. These engineers, engaged in international competition and thereby competing with American engineers around the world, have the distinct advantage of having language proficiency in the countries in which they are working. With the language proficiency comes a better understanding of the foreign cultures with which they are working, and the history and institutions of those countries. Moreover, it conveys a sense of respect for the people of those countries because they have taken the time to learn the language.

The curriculum at TIT does not leave room (really none) for a study of the humanities, social sciences, and the arts, while American engineers are required to take approximately 50% of their curriculum in these areas. TIT students are clearly narrowly focused. However, I suspect that by now they may also be taking some foundation courses in business administration. What a competitive advantage they would have then: engineering and technology, language and culture, and business. And these are just undergraduate students.

International and Individual Financial Accounts

The January 14-16, 2006 issue of *The Economist* offers a historical look at the country's international accounts and individual savings rates. To put them into a comparable context, it looks at these accounts as a percentage of gross domestic product (GPD).

As you recall, the current account balance represents the dollar value of U.S. exports of goods and services minus the dollar value of U.S. imports of goods and services. The U.S. current account balance since 1960, as a percentage of GDP, shows the following:

1960	1%
1970	0
1980	0
1985	-3%
1990	0
2005	-6%

The 2005 deficit in the U.S. current account is a historical record.

Household financial balances are defined as individual disposable income (total income minus income taxes) minus consumer expenditures (this difference is the "household savings" rate). Since 1960, U.S. household balances as a percentage of GDP are:

1960	2%
1970	2%
1980	7%
1985	2%
1990	3%
2005	-4%

The -4% figure means that individual households, on average, are spending 4% more than they are earning through reducing their savings accounts, taking down equity in their homes, or borrowing.

These trends are disturbing to say the least. If they continue, they threaten and will ultimately undermine the American economy. Right now, we are vulnerable to the whims and actions of the international community because of the large negative current account balance. We are also vulnerable to the dire consequences of a major domestic economic or terrorist setback because of the negative saving rate.

Misery Index

The Initial Misery Index was invented by American economists in the 1970's. It was defined as the sum of the unemployment rate and the inflation rate. It was meant to provide a quick gauge of the economic health of the country. You will remember those years of "stagflation", when both the unemployment and inflation rates were in double digits (along with the interest rate). If we compute the Misery Index historically and bring it to the present, the United States fares pretty well, over time, particularly in comparison with Europe which has experienced extremely high unemployment rates.

Economists at Merrill Lynch have devised a broader internationally focused index as the new "Misery Index". In addition to the unemployment rate and the inflation rate, this new index also includes the interest rate (defined as the 3-month T-bill rate), the federal budget balance, and the current account balance. These are add-ons. The Index then subtracts GDP growth, since growth in GDP is a positive factor. That is to say, low unemployment, inflation, and interest rates are good and high rates are bad; positive budget and current account balances are good and negative balances are bad; a high GDP growth rate is good and a low rate is bad.

The new Misery Index paints a bleak and threatening picture for the United States when compared with the G7 countries (Canada, France, Germany, Great Britain, Italy, Japan, and the U.S.). The negative picture is created primarily by the significant deficits

the U.S. has in the federal budget and current account balances. Today is in stark contrast to the picture in the 1990's.

For example, in 1994, the U.S. had the second lowest Misery Index (14) among the G7 countries. Japan was lower at around 6. The other countries in increasing order of misery were:

Germany	19
Canada	20
France	22
Britain	27
Italy	28

In 2005, the U.S. has the largest Index number and is the only country to see a large increase over the 10-year period. Japan showed a slight increase during this period; but it was also coming from the lowest base of all the countries. All the other countries showed significant decreases in Misery.

For example, in increasing order of Misery again, we have:

Japan	6
Canada	7
Great Britain	11
Germany	13
Italy	16
France	17
United States	19

Canada, over the last ten years, has had the biggest reduction in its Misery Index of any G7 economy (from 20 to 7 or a reduction of 13). It is the only country among the G7 running both current account and budget surpluses.

Key Component to Meeting the Challenge

I submit that education, at the K through 12 and university levels, is the key to meeting this global challenge. However, education currently is working against us, both at home and abroad. We turn to this next.

EDUCATION: WE SEE THE ENEMY – IT IS US

International Comparisons

We are increasingly lagging behind in Science, Technology, Engineering, and Math (STEM) when compared to other countries. For example:

- In recent years, in Japan 66% of undergraduate degrees awarded were in STEM, in China it was 59%, in Taiwan it was 41%, in South Korea it was 33%, and in the United States it was 32%. Specifically in engineering, 46% of China's degrees are in engineering, 25% of Russia's degrees are in engineering, and 5% of U. S. degrees are in engineering (Trilogy Publications, 2004).

- Today, the United States ranks 17th in the proportion of the college-age population earning STEM degrees. Several decades ago, we were 3rd.

- The number of high school graduates entering STEM disciplines has been declining in absolute and relative numbers over the past five years. As a consequence, the United States now imports foreign scientists and engineers; specifically, 20% of professional engineers in this country are immigrants.

- Over half of the doctorates awarded by American universities in STEM disciplines are awarded to foreigners.

- In 2003, 2.8 million bachelor's degrees in STEM were awarded worldwide: 1.2 million to Asian students in Asian countries, 830,000 to students in Europe, and 400,000 to students in the U.S. In 2004, 600,000 engineers graduated from universities in China, 350,000 in India, and 70,000 in the U.S. ("Rising above the Gathering Storm", National Academy of Science, 2005).

- In the fourth grade, U.S. students score above the international average in math and near first in science. By the eighth grade, they score below the international average in math and only slightly above it in science. By the twelfth grade, U.S. students are near the bottom of a 49-country survey in both math and science, outperforming only Cypress and South Africa.

- U. S. Labor Department statistics tell us that the number of openings annually for information technology and computer science graduates through the year 2012 will be 145,000. However, the number of expected degrees awarded annually is 75,000.

New York State and the Nation

What is happening in New York State mirrors what is happening in the rest of the United States. For example, the number of bachelor's degrees conferred in New York State in STEM has been dropping steadily over the past ten years. Specifically, from 1984-85 to 2004-05 (much of the data cited comes from "Regaining New York's Competitive Edge: Increasing Engineering, Math, and Science Majors", Commission of Independent Colleges and Universities, January 9, 2006):

- Engineering degrees have declined 36%.
- Mathematics degrees have declined 25%.
- Physical Sciences degrees have declined 33%.

- Only Biological and Biomedical Science degrees have increased (by 4%).

Over the past twenty years in New York State, the number of engineering degrees conferred has dropped, while the portion of international students receiving engineering degrees at all levels has increased. For example, comparing 1984-85 to 2004-05, the number of degrees awarded to international students increased:

- From 6% to 10% at the undergraduate level, from 24% to 27% at the master's level, and from 46% to 71% at the doctoral level.

The picture remains bleak as we review the results of New York State Regents exams in math and science. Taking the cohort of students who entered kindergarten in 1991-92 and were seniors in 2003-04, we find that:

- 81% sat for the biology exam (that is good).
- 55% took the chemistry exam (not so good).
- 42% took the math B regents exam (worst yet).
- 20% took the physics regents exam (worst of all).

Moreover, of these students, only 15% scored more than 84 on the chemistry exam, 27% on the math exam, and 23% on the physics exam. In effect, a small number of students sit for these key exams. Moreover, a small percentage of those who do sit do well. Examining this situation across the United States, it is estimated that less than 15% of U.S. students have the prerequisites to pursue STEM degrees in college.

If underlying conditions do not change and current trends persist, the national demographics exacerbate the program tremendously. For example, it is estimated that somewhere in the years 2040 to 2050, minority populations will represent a majority of the total U.S. population, both in school and post K-12. Hispanics will lead the way at 30% of the minority population, followed by African Americans at about 15% - 17% of the population. If we take a look at African American and Hispanic American students today, we find that 39% of the U.S. high school population is made up of African Americans and Hispanics. Yet, today, this population represents only 6% of the STEM workforce and only 7% of undergraduate and graduate degrees are awarded in STEM disciplines.

MATH WILL ROCK YOUR WORLD

The heading for this section is the title of the lead article and cover page of the most recent issue of *Business Week* (Baker S. and Leak B., "Math Will Rock Your World", January 23, 2006, iss. 3968, p. 54 ff.). Quoting from this article:

> "The world is moving into a new age of numbers. Partnerships between mathematicians and computer scientists are bulling into whole new domains of business and imposing the efficiencies of math. This has happened before. In past decades, the marriage of higher math and computer modeling transformed

> science and engineering. Quants turned business finance upside down a generation ago. Data miners plucked useful nuggets from vast consumer and business databases. But just look where the mathematicians are now. They are helping to map out advertising campaigns. They are changing the nature of research in newsrooms and in biology labs, and they are enabling marketers to forge new 1-1 relationships with customers. As this occurs, more of the economy falls into the realm of numbers. Says James R. Schatz, Chief of the Mathematics Research Group of the National Security Agency (NSA): 'There has never been a better time to be a mathematician.'"

The article goes on to say:

> "This mathematical modeling of humanity promises to be one of the great undertakings of the 21st Century. It will grow in scope to include much of the physical world as mathematicians get their hands on new flows of data, from atmospheric sensors to the feeds from millions of security cameras. It's a parallel world that is taking shape, a laboratory for innovation and discovery composed of numbers, vectors, and algorithms."

I am taking time to speak to math as a specific STEM discipline for two reasons. First, math provides the foundation and is the fundamental building block for all of the other STEM disciplines. Second, math by itself is a driver of creativity, innovation, and productivity. I believe that the single greatest reason for the lack of students in STEM disciplines is the fact that too many students cannot get past the gateway discipline of mathematics. If you cannot master your introductory math courses, particularly through the basic calculus courses, you cannot begin to be effective and successful in other STEM disciplines.

And where do we stand today? It has been estimated that in the United States the number of professional mathematicians is approximately only 5,000. I believe we have to exponentially grow that number to meet the global and domestic challenges that face this nation that are being discussed in this paper.

MEETING THE CHALLENGE THROUGH DIVERSITY

A diverse society is one in which everyone, particularly racial/ethnic minorities and women, has the opportunity to participate fully in the life and work of society. Historically, the key argument for achieving diversity has centered around "social justice". This argument remains relevant today.

I would like to emphasize another argument which is particularly relevant today, an argument which goes directly to our individual and national self-interest. It is a pragmatic argument. Simply put, we need minorities and women to participate more fully if the democratic freedoms and quality of life that Americans enjoy are to be sustained in the years ahead.

In basic terms, we need more women and minorities in STEM professions in order to maintain our competitive position with the rest of the world, economically, politically, and militarily. In other words, in order to retain our position of world leadership, we need to have a significantly increasing share of our workforce in STEM, and it is not happening – in fact, it is going the other way. Former President Clinton was on the RIT campus meeting with the faculty, staff, and students, and making a presentation on December 14, 2005. He introduced this very topic. He pointed out that if we could get women and minorities to participate in STEM disciplines (he did not use the acronym STEM) at the same rate that white males participate today, we could solve our global and domestic problems going forward in the areas I have talked about in this paper. He could have said we should just increase the percentage of white males going into STEM. I think he realized that while there could be some give here, there certainly is a need to have other disciplines explored fully. Moreover, not everyone is suited to STEM, and maybe the number of white males that we have in STEM disciplines today is fairly close to what the maximum figure could be.

However, 57% of students in college today are women. The percentage of women in STEM disciplines varies from 5% to 24% (excluding biology). If we could raise those numbers to the same level as white males, we will be well on the way to solving our problems within a very few years (U.S. Government Accountability Office, October 2005).

Of course, as time goes on, it will be increasingly important to engage minorities in STEM discipline. As I indicated earlier, minorities are a rapidly growing percentage of the U.S. population (attributable both to higher birth rates and immigration) and the Caucasian population is barely (and not even that) reproducing itself.

The optimum answer is to have more people – men and women, majority and minority – committing to STEM right away. The reality is that, in the short run, women provide our best advantage and, in the long run, it is women and minorities.

Why are there not a lot more women in STEM? The president of Harvard University recently – and unfortunately – made statements which have been widely interpreted as indicating that women may not have the intellectual capacity or the professional resolve to make it in STEM. Whether or not this is what he intended, this is what has been conveyed. Of course, he is obviously wrong on both fronts.

But why are women, again, so underrepresented? Many people believe it has to do with culture. Too often, women are told that they do not like math and science and they are not good at math and science; these disciplines are reserved primarily for men. Decades ago this was reflected by the fact that when women went to college, they intended to become teachers and nurses. I remember twenty years ago when I taught classes in business, economics, math, statistics, and engineering that I seldom saw a woman in any of the classes at the undergraduate level and rarely at the graduate level. Today, the majority of students in MBA programs, law schools and medical schools are women. The culture changed in these disciplines.

However, the culture has not yet changed for women in STEM disciplines. We must work to make that happen. Teachers, counselors, and parents must emphasize to women that they are welcome and can be just as successful as men in these disciplines. This should happen in pre-K and throughout K-12. One of the problems, of course, is that most of the mothers are not from these disciplines, and so they cannot serve as role models. Moreover, most of the teachers in these disciplines in K-12 are also male and not female. Finally, many of the teachers in K-12 – male or female – are not sufficiently qualified to really teach math and science. Some are ill-prepared or just drafted into these disciplines. It is hard, in these situations, for the students and teachers to project excitement and interest in STEM.

If I could divert for a moment and reflect on my own career as it regards women in leadership roles, I would like to point out the following.

When I first became Dean at the University of Cincinnati, 13 people reported directly to me. None of them were women. When I left that office ten years later, 7 of the 13 of my direct reports were women. I then moved on to the University of Hawaii where I was president for nine years. When I started, there were 13 people reporting directly to me, none of whom were women. When I left, nine years later, 7 of the 13 people reporting to me were women.

When I came to RIT, of the 15 people reporting directly to me, none of them were women. Right now, 8 of the people reporting to me are women.

Why is such the case? I must honestly say that I have never deliberately tried to recruit a woman - not ever. I simply have tried to recruit the best person possible. I have insisted that there be women and minorities in the pool to be considered but once they are in the pool, I immediately became gender- and color-blind. I was looking for the best people. I wanted the pool from which we selected to be as large as possible. As it turned out, the majority of the folks in my last three places of employment turned out to be women. Why? How come?

These questions occur because the number of women that I could consider for these administrative positions has always been small. Often women represented only 5% or 10% of the relevant pool. Yet, I hired them at more than a 50% rate.

I have a theory to explain this phenomenon. It goes like this. There is subtle and not so subtle, conscious and subconscious, and subliminal discrimination against women in certain disciplines and women for leadership roles. It is ingrained in the culture. Nonetheless, certain women rise up against these odds and overcome the obstacles before them. They manage to fight their way into the top 10 to be considered and then the top 4 or 5 to be considered. When I look at the top 5 and find one woman and four men (a 20% ratio of women to men in this case), I nonetheless end up hiring a woman more than 50% of the time. Again, why? My answer is that I am just looking for the best person. For me, the best person starts out with someone who has the highest level of integrity. It is

very hard to judge that, so I do the best I can and all the candidates typically trade off about the same in that regard.

Next, I look for work ethic, smarts, and toughness. I look into their eyes. I talk with their references. I challenge them one-on-one. The people who score the most points on work ethic, smarts, and toughness are the ones I hire. They happen to be women because, given the cultural barriers they had to overcome, if they did not work harder than everyone, if they were not smarter than everyone, and if they were not tougher than everyone, they would never get to be in that final pool of five. By going with work ethic, smarts, and toughness, I tend to end up with women. That is my theory, in any event.

I must tell you, in all my years in all of these jobs, while I have been disappointed by men and, in fact, have fired unceremoniously a number of them and more graciously replaced others, the only experience I have had with women is promoting them when I can, recommending them for higher positions elsewhere when I did not have a place to move them, and thanking the heavens that I had them on the team. My point is that women certainly are qualified in every respect for roles in STEM and leadership, and especially, leadership roles in STEM. We have to figure out how to accomplish this. I turn to that next.

PROGRESS TOWARDS A SOLUTION

If I had an ironclad sure answer to the challenges introduced, I would be flying all around the county, state, and nation trying to expedite it. I am not flying, but I have been participating in the issue and some solutions for a number of years. Let me offer some suggestions by reviewing the proposal by the Commission of Independent Colleges and Universities (cIcu) recently articulated at the State legislature. (cIcu is a lobbying and research group representing the 109 independent colleges and universities throughout the State of New York.) I served as Chairman of the cIcu Board from 2000 to 2002. At that time, I argued strenuously and effectively, I thought, for some of the proposals that are being offered now. In fact, one or two of the most important ones were favorably reviewed by the budget director and the governor – and then the recession hit. cIcu has been assiduously and steadfastly working on these and other proposals in the interim.

Actions that we as a State can take within the current environment will be listed below. If all of the states across the nation undertook similar steps, as a nation we will be on our way. However, the steps have to be taken quickly and – importantly – they have to be undertaken vigorously with outcome measurement and follow through. Appropriate resources, coordination, management, and tough leadership have to be part of any successful implementation.

Specifically, the action steps would be the following:

- Increase math and science teachers by providing 1,000 scholarships of up to $10,000 per year for those students who commit to teaching math and science in New York State for up to five years. Preference could be given to applicants

with family incomes under $75,000. This program would cost $10 million in the first year and $50 million when it was fully phased in.

- Increase the number of engineers by offering 1,000 loan forgiveness awards of up to $10,000 per year. Recipients would have to commit to work for a New York located firm for up to five years upon graduation. This program will cost $10 million in the first year, and $50 million when fully phased in.

- Increase underrepresented students in math and science by expanding the STEP/C-STEP program. This is a program which offers 60% of its funding to support high schools and 40% to support colleges. The purpose of the program is to increase the number of historically underrepresented and disadvantaged students prepared to enter college and to complete college (at both the undergraduate and graduate levels) in STEM and health-related fields and licensed professions. The program includes the addition of counselors and mentors whose job is to be certain that high school students are encouraged to take the foundation courses necessary to be prepared for college programs in STEM. Currently, $9.5 million is dedicated to STEP/C-STEP, and another $2.5 million is being requested this year.

- Create eight math- and science-focused high schools throughout the state. The state is being asked to provide $1 million per year for each school.

- Increase the number of people who undertake mid-career changes in order to teach math and science by working with the State Education Department in implementing alternative teacher certification programs. This program would be available to retirees as well. The governor has requested, in his budget, $5 million for this program.

- Increase interest in STEM by encouraging internships and partnerships among colleges, businesses, and middle and high schools.

These are examples of where cIcu stands now in dealing with the challenge of STEM. This is a program which has the attention of the governor and the legislature. All of us are lobbying the legislature.

Every state in the nation needs to do this. Moreover, support for these state efforts has to be reinforced at the federal level. The Business Council of the State of New York, the Conference Board, and the Council on Competitiveness are also sounding their own clarions and introducing their own ideas for solution. Clearly, this is a national challenge and threat (and we certainly have numerous others) that must be dealt with.

CONCLUSION

Our nation is facing a major global economic challenge. We must successfully meet this challenge if the U.S. is to preserve its democracy, quality of life, and world leadership position. A fundamental key to meeting the challenge is to increase the number of K-18 students engaged in STEM. A pivotal strategy to achieve this goal is to enhance diversity in STEM disciplines.

Doing the right thing in terms of social justice simultaneously serves our pragmatic economic self-interest. In the short run, women provide our best approach. In the long run, it is women and minorities.

In the words of René DuBos:
"Human diversity makes tolerance more than a virtue. It makes it a requirement for survival." (*Celebrations of Life*, 1982).