

# 日本經濟經營研究所

CENTER  
ON JAPANESE  
ECONOMY  
& BUSINESS



COLUMBIA  
BUSINESS  
SCHOOL

## 6 $\sigma$ AND LEADERSHIP

TUESDAY, MARCH 7, 2000

*Six Sigma focuses on customer satisfaction, emphasizes data driven analysis, strives for product and process improvements and requires senior management involvement. But so does the standard Total Quality Management effort. What is different here? ■ On March 7, 2000 the Center on Japanese Economy and Business, the W. Edwards Deming Center for Quality, Productivity and Competitiveness, and the Conference Board's Global Center for Performance Excellence hosted a symposium to explore the relationship between Six Sigma and Leadership and to see what it takes for successful institutionalization of this effort. The symposium featured Larry Bossidy, Chairman of Honeywell; Roger Hart, Director of Quality and Six Sigma, Sony Electronics; and Henry Schacht, former Chairman and CEO, Lucent Technologies. Professor Peter Kolesar, Professor of Management Science and Operations Management, Columbia Business School, served as commentator. The symposium was moderated by Nelson Fraiman, Professor of Management Science and Operations Management, Columbia Business School. Excerpts of their presentations are presented below, along with highlights of the intra-panel and audience discussions.*

**LAWRENCE. A. BOSSIDY**

Quality does not necessarily mean what it meant ten years ago. A decade ago, conversations of that nature dealt with the quality of the product that one bought. For approximately five to seven years, the quality of the product consumers have purchased has been good. As you know, there has been intense global competition and there has been a metamorphosis in manufacturing capability, at least in the United States. Consequently, product quality has ceased to be a problem.

Today, quality is referred to in terms of first-pass yields or, in other words, the efficiency with which a product comes down the line. The question is no longer whether the product shipped to a customer will be good but, rather, what is the cost of attaining first-pass yields at 85-90 percent without inspection?

There are four essential questions to ask in order to understand Six Sigma; what is Six Sigma?, why is it important?, how is it deployed?, and who are the key players that make it work? Six Sigma is a customer-satisfaction focused continuous improvement process that aims to reduce defects. Six Sigma means 3.4 defects per million products manufactured, and it provides tools designed to both identify and correct these defects. Six Sigma is not a product. It applies to various processes that exist in every business and it has implications

for product design.

I think Six Sigma is recognized as a key way to grow. In other words, the better the product, the better the costs, and the better the opportunity to sell a product. It is essential to talk about growth and productivity together. They are not separate entities. Six Sigma must be applied to growth processes as well as the factory floor. In my company, we promulgated the initiative across the company to adopt Six Sigma. To some extent, we began in the factory, but then quickly went to every function in the business and asked them to apply it to their various processes. It had a terrific yield, well beyond the products of the manufacturer.

Six Sigma is often described as a DMAIC process; define, measure, analyze, improve, and control. Each one of the tools used is a way to identify defects, whether it is a process map, a capability analysis, or a multi-variant analysis. Six

Sigma teaches how to apply these tools to the process, identify the defects, and correct them. It is not complicated math. Rather, Six Sigma is basic, advanced statistics with an engineering quotient built in to help one understand how to use these tools effectively.

How is Six Sigma effective? Six Sigma operates project by project. The results are measured by the effects one project adds to another. It is important to pick the correct projects and to ask the people at the highest level of management to participate in the selection of the projects. One should also choose projects that, once corrected, will have the greatest impact on the business, whether they are manufacturing, building, or design processes. It is also important to train the people correctly.

In order to be an expert in Six Sigma, we train hand-chosen personnel to become black belts. A black belt's training consists of sixteen weeks; one week in the

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*- BOSSIDY*



*Lawrence A. Bossidy*

factory, one week in school, three weeks in the factory with a project, one more week of school, then back to the factory for four weeks. This process continues on a rotational basis for four months. Essentially, a trainee is taught specific Six Sigma tools in order to learn how to analyze defects. A master black belt is not only a person who has completed his/her training, but has also taught other black belts. A green belt might well be an administrative person who does not need to know all of the dynamics of a black belt, but nonetheless can take the Six Sigma methodology and apply it to functions such as marketing.

I think Six Sigma and the use of black belts saved my company approximately \$1 billion in costs. I know it has improved our ability to provide our customers a product we can feel good about. We take great pride in our black belts and use them for advertising. We also take the black belts and move them to our customer base, to see if we can be helpful to our customers, which is another way to distinguish ourselves from another supplier. I promote Six Sigma continuously and it is important to keep it visible.

Every unit has a Six Sigma master. The general manager of the SBU is accountable for Six Sigma results and we review those projects several times each year. Six Sigma leadership at AlliedSignal decides how many black belts ought to be on each SBU. Usually, we try to keep

black belts for two years and then try to accelerate their career through the company so there is a reward for doing it. We also choose people to become black belts rather than take volunteers since we want the best people possible. In our company we set the stage where it is a distinguished feature to be black belt. If we can accelerate their career growth, then it feeds upon itself and can become something to feel really good about.

However, if the CEO is not interested in Six Sigma, does not speak about it all the time, is not one of the messengers of what it is all about, then it wanes because everyone has another idea as to what should be priority on the list of things to do. But, if one perseveres, puts the right structure in place, completes the proper training, and then follows-up in terms of how it is working, it becomes a very significant breakthrough and produces excellent results.

#### ROGER HART

The vision of leadership created by Akio Morita has been well publicized. Sony's leaders have created an environment built upon the concept of innovation with technology and quality to create something new and different. This was heavily stressed to the engineers and the people at Sony in the early days. The concept evolved out of war time Japan and the Japanese effort to rebuild the economy. This was the image Sony recruited with

and has tried to maintain.

In the process of developing this concept, Sony's leaders also created the term, not invented here (NIH). A number of companies have this culture. They do not necessarily create it on purpose, or even want it, but it is sometimes generated. To some extent, this is not necessarily what Sony wanted either, but it was created out of Sony's culture; strive to be innovative, use technology for consumer products, and do it with high quality.

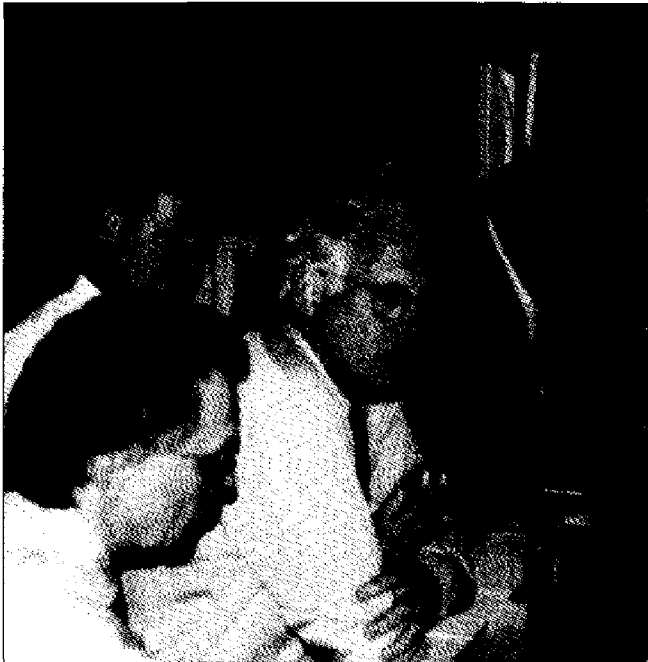
Today, Sony's environment is referred to as the Network Era. This age is characterized by the disappearance of borders and the emergence of the broadband, which means high volume video and media transfers. The network eliminates boundaries that divide countries and industries, such as manufacturing, information and services. Sony's new vision is to be a personal broadband network solutions company. This refers to a company that delivers customized solutions quickly and accurately to individuals anywhere in the world. As one might expect, Sony has no intention of merely surviving the network era; we want to lead it.

The CEO and President of Sony Corporation is leading two major initiatives to ensure the company achieves this vision. First is value creation management. The key to this plan is the use of economic value added as the metric. Profit is no longer a good metric and one must consider the cost of the capital to

achieve this initiative. Second is supply chain management. Sony Six Sigma is a world-wide deployment of this initiative to improve all of Sony's processes. From our perspective, one must apply Six Sigma to the entire company. One cannot deliver Six Sigma products without Six Sigma services and Six Sigma processes to get there.

How did Sony get started with Six Sigma? As we were analyzing how to improve our overall excellence, the former President and Chief Operating Officer of Sony Corporation of America arranged a meeting with members of Allied Signal, General Electric and Motorola to see what results they achieved through Six Sigma. We learned that Six Sigma was a proven methodology. It was not an experimental environment, but a hardcore proven environment. We knew we needed to continue building Sony's culture to achieve high quality and decided to move toward blending the current Sony culture with Six Sigma culture, which we considered to be more robust to contend with the future environment.

In February 2000, Sony conducted its first Sony Electronics Six Sigma Symposium. At the session, members were allowed to display what they had done on projects and give presentations. Participants also attended training sessions and we gave awards for the best projects or the combination of results and effectiveness. One of the most



*Peter Kolesar, Roger Hart, Henry Schacht, Nelson Fraiman, and Lawrence Bossidy*

effective aspects of the symposium was a consensus building item. We had a question and answer panel discussion comprised of different parts of the company who represented different business groups. The session was videotaped and circulated to all transactional divisions within Sony to use as a deployment creating element (transactional divisions include groups like marketing, human resources, accounting, and other non-manufacturing divisions). Sony is putting in a substantial effort to promote Six Sigma understanding and training within the organization. This is not a corporate function — business leaders and members within each organization are getting trained.

Six Sigma is developed

through projects and one focuses on applying the tools to these specific projects. One example of a Six Sigma project involves our accounts payable organization. All of Sony's major organizations have travel and expense processing through the accounts payable division. At one of our organizations, it took eight days to get an expense report processed. The reason why the process was so slow was because 30 percent of the expense reports had defects in them. This was a hidden factor. When we gathered the data and understood more about what was going on in that environment, we learned that they were counting a mistake according to the metric used by the division. Sony leadership asked the division to change the metric they

were using to process the expense report.

At Sony, Six Sigma is building a new culture. It blends the unique Sony culture that existed before along with the proven implementation methodology of variance reduction. It employs disciplined application of the tools and the creation of a common language. It includes spreading the culture into the transactional areas, and one must keep a continuous watch on the cultural impact that is being handled in the particular country.

#### HENRY B. SCHACHT

I would like to take a slightly different approach and talk about process as opposed to Six Sigma itself. I will also share some thoughts about Cummins Engine experience in tackling this issue in the early 1980s; some reprise in the 1990s; and then some discussion about process going forward. I think some of the issues we faced in the early 1980s in the U.S. commercial sector are about to surface again, and we will put a significant stress on our Six Sigma activities in ways that we do not yet know how to deal with.

The Cummins experience starts in the late 1970s, early 1980s, when we arrived at a very unpleasant conclusion, as many other U.S. manufacturers did at the same time. At the time, U.S. manufacturing was leading without any competitive pressures. We conducted our measurement system against

ourselves, we had a European bias, and we were not paying any attention to the Far East at all. In the early 1980s, we woke up to find that we were massively non-competitive with a Japanese production machine that was sweeping market after market in the U.S, whether it be automobiles at 23-25 percent of the shares, or motorcycles at 80 percent. We began to think that there might be something fundamentally wrong. Cummins was particularly worried about that because it was bringing out a new line of product that was very costly and it was going to be competitive with the Japanese for the first time. We had a partner in Japan called Komatsu, and we could never quite understand how they were able to do so well in terms of production efficiency when we were unable to do nearly as well with four to five times the volume. We spent a significant amount of time doing analysis and concluded that the Japanese were at an index figure of one on costs, the Europeans were about 1.3, and we were at 1.35. This is 30 percent out of pocket in a business that made 3-4 percent in good years.

Our analysis of quality was equally as shocking. We considered ourselves the best in the world. We measured ourselves against our previous quality and against quality set by Western manufacturers. We found ourselves to be 3-4 times out of pocket in terms of incidence of failures, we had high costs and

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— HART

low quality, and we were about to compete with the Japanese who had low cost and very good quality. In 1980-1981, we decided to get serious about quality and cost and launched a serious effort to turn the situation around. We set goals that would achieve best in class cost and quality over a relatively short period of 3-4 years. After about two years, nothing had happened and we needed to figure out what was going on. We decided that our employees simply did not believe we had an issue of such magnitude. We had too many answers and concluded that super good quality cost too much. We also knew that continuous improvement was an engineering impossibility and that our accounting system was a problem, since there was no apparent capture of all of the costs in the quality.

Our answer to the problem was to go through a massive amount of benchmarking. We shipped plane loads of people to observe Komatsu's operations in Japan, including union and first line supervisory personnel, customers, and service people. It slowly dawned on our people that the burning platform we had seen was very real and life-threatening to their jobs. Essentially, our people needed to decide for themselves that things at Cummins were critical, and management could neither impose on them the urgency that was going to be required, nor set standards for them that they did not believe in.

We started to make progress when we arrived at benchmarking which, in hindsight, seems so simple. One learns in this business over and over again that good people, faced with evidence they both believe and can identify with, will set higher goals for themselves than anyone else can impose on them. They will get there faster and it will cost less if massive cultural change is required. If cultural change already exists, then strong leadership is the key to improving business.

The missed lessons were that people do set higher goals for themselves and that improvements cannot be done piecemeal. You must start with design and finish with after sales service. You cannot get to Six Sigma today if you only start in manufacturing. This seems obvious now; it was not obvious then. Each of the elements in the chain play a vital role. The concepts are deceptively simple and the execution details are grindingly excruciating. They must be appreciated for what they can tell us and for what needs to be done.

Finally, you must treat Six Sigma like a business imperative. You have to get by in the front, have top-level support, set appropriate measures and goals, have the appropriate responsibility, authority and funding, and you must have sensible time gates for the people involved. Compensation must serve as a reinforcer, and the best people have to be employed, not the

available people. If cultural rigidity exists, it is a good idea to use demonstration projects. Take a simple division and example and show everyone what can be done.

How did we do, how long did it take, and what were the results? We started early and used most of the Six Sigma tools. From start of effort to finish, it took us eight years.

Cummins now produces twice as much product with half the people, half of whom get paid half of what they used to receive as compensation. This is about an eight-fold increase in productivity. We took almost 40 percent out of our costs. Today, Cummins is a \$7 billion company. We are currently at about four-and-a-half out of Six Sigma. In terms of cost, we are considered the leader in the world. The Japanese are at about 1.15. In terms of quality, we are at four-and-a-half out of Six Sigma.

I think the business processes we have been improving on and the business processes we have been substituting for less cost effective and lower quality processes are about to become obsolete. There are two powerful factors at play. I am astonished at the improvement in computing power that is about to descend on us. We are about to increase our computing power from today's capacity by 8-10 times. In the planning horizon for our businesses, we will have unlimited computing power at zero incremental cost. At the same time, we expect

unlimited transmission capacity at zero incremental cost. Businesses are going to need to live with this and it will crumble the current business model. We are already talking about outsourcing all of our manufacturing and doing our process design worldwide. Conducting an end-to-end low-cost high quality system in a totally fragmented business model is now upon us, and we do not have a clue. In my opinion, we will need to think of another cultural change which will require completely different thinking about business processes. Again, this will bring up the issue of cultural change and how one applies Six Sigma thinking to a fragmented business model.

**PETER J. KOLESAR**

There are some barriers and problems that I would like to expose about Six Sigma which are too important to be left unexamined by informed, neutral critical observers. We really need to test whether the value that is claimed is really there because in the year 2000 we are faced with something that really troubles me; Six Sigma as a worldwide salvation business.

I see a number of distinct differences between Total Quality Management (TQM) and Six Sigma. First is standard. There is something extraordinary about talking about 3.4 parts per million and meaning it. It is a different way of articulating zero defects. However,

there is a plus side and a minus side to it. What happens to an organization when you articulate such an extraordinary goal, and you do not achieve it?

Second is intensity. The methods and the philosophy are virtually identical, but this time, companies like AlliedSignal and Sony really seem to mean it. The investment, time and energy of people like the CEOs is proportionate to the task.

Third, Six Sigma is a very different quality movement. The by-norm orientation from start to finish, from justification of the projects, monitoring the projects and making sure that they are re-institutionalized has changed immensely.

Fourth, the implementation infrastructure is different. The two most important aspects in this interlocking infrastructure are called the Champions and the Blackbelts. Champions are blind managers who are accountable for making the process work. The blackbelts, who advise the champions, are also managers who are technologically skilled in statistical methodology.

Fifth is the fundamental importance of a top magnate drive, a very strong personality. However, can Six Sigma succeed without strong leadership and, if so, for how long?

I am concerned about the Six Sigma of the Six Sigma. Let me be an iconoclast and say: Six Sigma in every process? I find that to be a problem. Is it eventually dysfunctional to have

standards that cannot be met? I am a cautious supporter of it. What is the payoff? According to General Electric's 1998-99 Annual Report, for example, the claims are incredible. In one business unit making industrial diamonds, the improvement in operating margins were 9.8% to 25%. Manufacturing costs were down by order of magnitude. Yields increased by 500%; on time deliveries; product quality improved; billing errors; working capital increased by 40%. What does it take to make Six Sigma work?

GE's investment is extraordinary. They have invested \$1.5 billion in Six Sigma activities since 1996. They have trained on a massive scale. The company hired approximately 600 outside statistical experts; trained 5,000 black belts; 60,000 green belts; and 230,000 employees. This is an enormous change and they have the managerial effort to do it. Black belts are full-time implementers. One cannot use volunteers or those who are available; you have to use those who are the best. Many organizations do not have the slack, or do not believe they have the slack to free up the best people to do this job. I think that is a very significant managerial leadership challenge.

*ONE LEARNS IN THIS BUSINESS OVER AND OVER AGAIN THAT GOOD PEOPLE, FACED WITH EVIDENCE THEY BOTH BELIEVE AND CAN IDENTIFY WITH, WILL SET HIGHER GOALS FOR THEMSELVES THAN ANYONE ELSE CAN IMPOSE ON THEM.*

*- SCHACHT*

## QUESTIONS & ANSWERS

**Q:** How long does it take to get Six Sigma operational in a company and is there a significant increase in overhead during Six Sigma implementation?

**BOSSIDY:** Six Sigma can be operational in three to six months, due to the training. We use the Six Sigma Academy in Phoenix and then trained our own trainers. The cost was approximately \$50 million to implement. Compared with the saving, there is a very nice payback.

**Q:** Is there a place for Six Sigma in the service industry?

**BOSSIDY:** I think Six Sigma can be applied to big transactional companies, like credit card companies, where there are multiple transactions. I think Six Sigma will be steered in that application in a way that is effective. However, I would study the playing field before I decided which team to put on.

**HART:** Service industries do compete. From the standpoint of competition, if you have a service industry where in a competition standpoint, your competitor is beating you significantly, then you better figure out how to do your processes better than they do. For example, in the electronics industry, when we introduced the computer part of our business, the service industry changed radically for us. We spent 24 times as much service cost for computer product than



Roger Hart, Henry Schacht and Peter Kolesar

we do for television or radio. If you do not understand your cost structure and you do not link it financially to your improvement activity, you are going to get in trouble.

**Q:** What elements make Six Sigma sustainable?

**BOSSIDY:** Every year there is a productivity objective in our operating plan, and I like to look at the projects before the year unravels. In other words, for the year 2000 the projects should be identified. Generally, they're all Six Sigma projects. I like to see when they are going to be implemented throughout the course of the year, and what impact they are going to have. The process becomes routine, and my job is to continue to highlight its impact and importance in order to sustain it. It is important to be evangelical so that people understand how important it is. I think the leader has to have interest in it. He must become acquainted with it and meet with black belts all the time. The leader must stay involved with Six Sigma activities all the time so

people recognize that it is still of high importance

**Q:** Given a world in which more and more processes are dependent on information technology, and given the speed at which information technology capabilities are changing, is it possible to talk about continuous improvement on processes that are going to have shorter and shorter life times?

**SCHACHT:** I think the answer to that is yes, but I think the time frame changes substantially. One of the challenges we face in what I call a disperse business model is that processes will have to change completely. Hopefully the processes will be less intricate, more IT driven and require less human intervention. However, the same process of continuous improvement has to be applied because if you apply it and somebody else does not, then you will be non-competitive. Ten years ago, we rolled trucks and hired drivers to install, maintain and to fix. We now have 97% remote diagnostic capability, and 98% remote repair. If you would have taken

TQM or Six Sigma to improve our I&M business with trucks and people, you could have gone forever right out of business. This is what I mean by our whole business models are going to change. As they change it will require continual application of continuous improvement while we change. Time frames are going to collapse on us, but the basic motivation of lower cost and higher quality will drive process changes.

**Q:** How does Six Sigma operate in different countries at different stages of development?

**BOSSIDY:** I think it operates well. Six Sigma is a worldwide program. We have worldwide blackbelts in every part of the company. It might be deployed differently in Japan, Europe and Latin America, but the arithmetic is the same and therefore translates very well. If a company decides to deploy Six Sigma differently in a way that is more consistent with their culture, I think that is fine. At the end of the day, the company is still trying to get high quality and low costs.

コロンビア大学ビジネススクール日本経済経営研究所シンポジウム

## 「シックス・シグマとコーポレート・リーダーシップ」

2000年3月7日  
於 コロンビア大学

日本経済経営研究所は、エドワード・デミング・センター及びボーディス・グローバル・センターと共催で、「シックス・シグマとコーポレート・リーダーシップ」というテーマでシンポジウムを開催した。シックス・シグマという経営革新コンセプトがTQM(Total Quality Management)等の従来からのコンセプトとどこが異なるのか、またシックス・シグマの導入によって成果を得るためには経営者にどのようなリーダーシップが求められるのか、等がこのシンポジウムの中心テーマである。パネリストとして、ラリー・ボシディー氏（ハネウェル会長兼CEO）、ロジャー・ハート氏（ソニー取締役）、ヘンリー・シャクト氏（元ルーセント・テクノロジー会長兼CEO）が参加、ピーター・コレサー教授（コロンビア大学ビジネススクール）がコメンテーターを務め、シンポジウムの進行をネルソン・ノエイマン教授（コロンビア大学ビジネススクール）が行った。以下でシンポジウムでの討議内容を簡単に紹介する。

シックス・シグマ（ $6\sigma$ ）とは、ビジネスの過程におけるあらゆるエラーを100万回に3~4回の頻度に収めるようなシステムをビジネス過程全体で構築しようとする経営革新コンセプトである。その性質上、このコンセプトは工場における生産プロセスだけではなく、ビジネスの全過程に適用することが可能である。シックス・シグマは別名DMAICプロセスと呼ばれ、その適用プロセスを、define（問題の把握）、measure（測定）、analyze（分析）、improve（改善）、control（改善結果定着のための管理）、の5つのプロセスに分けて考える。このプロセスが有効である一つの理由は、この過程がプロジェクト毎に行われることであり、当然そこからの教訓は他のプロジェクトに生かされることになる。また、シックス・シグマの各過程を担う人材の育成も非常に重要で、いわゆる社内コンサルタントとも言うべき“ブラック・ベルト”の養成がうまくいくかどうか、シックス・シグマの成功を左右する。

ボシディー氏は“ブラック・ベルト”の活用でハネウェル社では年間約10億ドルのコスト削減がなされたと述べ、CEOがシックス・シグマの手法に興味を持ち、絶えず社員にその手法を意識させることができるかどうか、結果を左右すると指摘する。また、ハート氏は、ソニーの経営陣は従来から技術革新とその質の向上を重視するビジネス文化を社内に作り上げてきたが、この文化とシックス・シグマの考え方の融合を現在試みつつある、と言う。一方、シャクト氏は、80年代米国企業が製品の品質面で日本企業に大きく遅れをとり、その差を何とか縮めようとするための方法論として、シックス・シグマが試みられ、その有効性が高まってきた面を強調した。コレサー教授はシックス・シグマとTQMの相違点を示しつつ、シックス・シグマによる成功のためには人材への膨大な投資が欠かせない点に特に注意を促す。社員の自発的な参加では全く不十分で、経営者が最高の人的資源をシックス・シグマの過程に集中させる意思決定を下せるかどうかは、非常に難しい経営判断にならざるを得ない、と指摘する。

その後の質疑応答では、シックス・シグマのサービス産業への応用、IT化の進展で従来より格段に速い経営スピードを要求する昨今の経済・経営環境でも漸進的な経営改善のコンセプトは有効なのか、などの諸点につき活発な議論がなされた。

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