

## Innovation and Organization Advancement



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Aloha!

My dear brothers and sisters, thank you for coming today. I am grateful for the opportunity to address you in this special convocation. I have always loved learning, and appreciate the opportunity that Dean Burroughs and others have provided for me to share some of the results of my own research and that of several close colleagues.

It is clear from the Lord's many revelations to the prophet Joseph Smith, that learning and furthering one's education, especially when combined with obedience to God, is not just desirable, but a divine commandment. Furthermore, the benefit of such learning accrues to us not only in this life, but continues into the eternities.

To the benefit and blessing of all of His children, the Lord has made clear that in the last days, the dispensation of the fullness of times, all things will be revealed. Let me refer to one of the sections of the Doctrine and Covenants where the Lord made abundantly clear to the Prophet Joseph Smith, the magnitude of all that was soon to be revealed. The wonderful and instructive Section 121 of the Doctrine and Covenants contains the following:

"God shall give unto you knowledge by His Holy Spirit...that has not been revealed since the world was until now."

The Lord went on to say that it would be "[a] time...in the which nothing shall be withheld...All thrones and dominions, principalities and powers, shall be revealed... And also, if there be bounds set to the heavens or to the seas, or to the dry land, or to the sun, moon, or stars--All the times of their revolutions, all the appointed days, months and years,...and all their glories, laws, and set times, shall be revealed in the days of the dispensation of the fullness of times."

While we might be tempted to think of "all things in Christ" as referring only to spiritual matters, we know that with God all things are spiritual. He knows and understands all the concepts, laws and principles that govern this universe. He is omniscient and he can and will instruct us "more perfectly in theory, in principle, in doctrine, in the law of the gospel, in all things...that are expedient for [us] to understand."

History confirms for us that indeed during the period from the 1400's to the start of the 1800's, not only were the necessary conditions established for the restoration of the gospel, but a foundation of basic understanding relating to the physical, mathematical and other sciences was also put in place, so that the dispensation of the fullness of times could begin with the calling of the Prophet Joseph Smith. The record of the past 200 years testifies that the Lord is true in fulfilling His promises.

Since that day in a grove of trees in upstate New York, there has been a veritable explosion of secular knowledge and its application for the betterment of mankind. Starting with railroads and steamships, it has progressed to factories, the telegraph, and then to cars, telephones, airplanes, computers and even rockets. And more recently, the developments of the internet, of medical science and of a myriad of consumer products have further blessed our lives and facilitated the continued spread of the gospel to every nation, kindred, tongue and people.

I am grateful to a loving Father and His Son for the blessing it is to live in the fullness of times. As I reflect on all the Lord has revealed and will yet reveal, I'm deeply humbled as I consider the efforts and results that myself and several close colleagues have been able to make it one small corner of this world of innovation and discovery.

Since there are many approaches to the study of innovation and discovery, let me begin by describing and illustrating three of the most common. The first is what might be termed the brilliant innovator or entrepreneur model. It recognizes that there are a number of individuals who are extremely creative and who seem to have an unending stream of new ideas. And when supported by an appropriate organization, they can spawn whole new product families and fields of endeavors. One example of such a person would be Thomas Edison and his vast array of electrical products which eventually formed the basis for the General Electric Company. Another would be Edwin Land, the inventor of the instant camera and founder of the Polaroid Company. In addition, many serial entrepreneurs have followed a version of this model.

The second approach is what might be termed the creative culture organizational model. Throughout an organization following this model, innovation and creativity are encouraged and rewarded in order to deliver an ongoing stream of new product lines and services that can be launched successfully. A well-known organization of this type would be 3M with such break through product lines as scotch tape, post-its, sand paper, and many other industrial goods. Other examples would include Nabisco and Frito-Lay in food products, or more recently, Google with its many initiatives and emerging product lines in information services.

A third approach to innovation is that involving a systematic, ongoing stream of product generations in just a few product families. Under this approach an organization seeks to develop expertise in a set of related technologies, and then over time, continually deepens their understanding of those technologies and integrates them into products that serve large on-going markets. Such firms regularly apply advances in technology to an ever improving stream of products such as Intel in semiconductors, Toyota in automobiles, IBM in computers, Johnson and Johnson in scientific instruments, and Pixar Studios in animated movies. Each of these organizations has built a reputation for ongoing innovation across generations of products within a well-known family.

Over the past 25 years my academic efforts along with those of several close colleagues have focused on this third approach. We have sought to study how companies which purport to have as their goal, the development of new and improved products that benefit the world, pursue that ambition. In particular, we have tried to discover what makes some organizations far more successful at this endeavor than many of their counterparts.

In order to make our studies relevant to practice and credible to those involved in such activities, we began by

identifying a handful of industries where innovation and competition were rapid and unrelenting. We wanted industries where in a relatively short span of time a new product could be developed, introduced and then evaluated by the marketplace. Among the industries we chose were automobiles, computers and medical devices. Each of these focuses much of their activity on developing new technologically sophisticated products that will hopefully propel their organization to greater success in the market place.

Since many of the details of such innovation and new product development are not ones you may be familiar with, it might be helpful if I describe my research as falling into three phases. The first consisted of a diagnostic phase to understand the nature of the problems and challenges organizations face in such development efforts. The second consisted of developing concepts and terminology that would facilitate data gathering and the making of comparisons across development projects in different companies and industries. And the third phase consisted of analyzing those data to draw conclusions and insights that could be applied broadly by others. Let me briefly describe the results of the initial two phases and then focus on the third.

In the first phase of our work we studied in detail several dozen major new product development projects-- from the Toyota Lexus to the Honda Acura, from the Apple Mac to the IBM laptop, and from a Johnson and Johnson stent to an implantable Guidant defibrillator. One of the things we quickly learned was that they all were organized into individual development projects with a project plan consisting of milestones and project phases.

We also learned that all such product development projects typically had a set of three goals-- a budget, a launch date, and a set of market performance specifications. And we learned that every group working on a project always started with very high hopes-- their new product was going to perform better, cost less and be more timely in the market place than so many projects that had gone before. They knew their new product could correct past deficiencies and shortcomings, not only to benefit their company, but to the benefit of their personal reputations and careers.

Unfortunately, we soon discovered that most new product development projects fell far short of their promise. As individual tasks proved unusually challenging and failed to be completed on time, project time lines slipped and budgets soared. Then, because management had already made commitments to customers, suppliers and stockholders, such shortcomings were followed by additional pressure, which often served to add more costs and create further delays. The end result was that a project originally intended to take 12 months might instead take 20 months. And with such delays, added costs and a failure to match the competitive products already in the market, followed.

Government projects also often fall prey to these same challenges. During the past 15 years in downtown Boston there has been a project going on that is known as the "big dig." It is designed to put two major highways underground and add a third tunnel to the airport, and then to turn the above ground area into parks and open space. Originally approved as a five to seven year project costing \$4 billion, it has now been 16 years at a cost of \$15 billion and the above ground portion is still not completed.

Following the initial diagnostic phase of our research, in phase two we sought to develop a basis for comparing new product development projects across companies and industries. To this end we sought to identify, define and apply a set of concepts and terms that could be used in gathering data and comparing a variety of projects and their results.

Three concepts with their related definitions proved extremely useful in this second phase. One was the concept of a product generation and the related concept of a product family. Often product families and their generations can be identified easily by their product names. For example, in the software industry, Windows is a product family within which there have been several product generations-- Windows 97, Windows 2000, Windows

2003, and most recently Windows 2007.

Another example of product generations and product families would be the automaker, BMW, which has traditionally had three product families-- the Series 3, the Series 5 and the Series 7. Within each family there are multiple models, but those tend to vary only in minor ways from a design and manufacturing point of view. For a product family like the series 3, for almost five decades, every five to eight years the company has done a total redesign of the product family to incorporate new technology and new features and to adapt to emerging customer preferences. Each such redesign constitutes the next generation of that family of vehicles.

Such product families and their sequential generations add structure and clarity to product development efforts. Such a pattern allows a company to leverage new technology and features across a sizeable volume of products, while offering different product models within the family in order to increase appeal to market sub segments.

A second concept we found useful to define in this phase of our work was that of a platform project. While the company's development goal is not simply a single product, but rather a family of products, from our work we discovered that it is very helpful to initially design the major platform product -- that is the heart of the new product line -- and then to quickly design additional derivative products based on that platform design.

In each such case, the most efficient way to design and develop the next generation of products was to define and develop the platform product, with its accompanying specifications, and then to quickly turn that platform into several derivative models. A key implication of the concept of the platform product is captured by the old adage, "you can't make a silk purse out of a sow's ear." Similarly, in product development, if your platform project isn't right on budget, on time and on target for the market-- no amount of tweaking or adjusting is going to make it significantly better. Because of the leverage of the platform product in a new generation, my colleagues and I have chosen to focus primarily on platform product development efforts.

One final concept we found useful to define and develop was that of team type. Since all product development projects involve the integration of many different disciplines, functions and skills, they invariably require the involvement of a team of diverse people drawn from throughout the organization, its key suppliers and its customers. Initially in our product development research, we discovered that there were two dominant ways to organize these teams. That is, there were two primary team types-- the functional team and the autonomous team. Let me illustrate these two graphically:

In the functional team, people in each of the functions are designated as being on the team, but their desk or workbench remains in their functional area, and after each team meeting, they return to that area to do their work on the project. Their focus remains primarily rooted in their function and its activities. In the autonomous team, the team members are taken out of their functional areas and put together in their own work space. As you might expect, they quickly begin to identify with each other, their project and its goals.

Because of the many advantages and disadvantage of each of these two types of teams, we also discovered that some companies were defining and using two other types of teams, each of which tried to combine the strengths of one of the dominant types, while reducing its disadvantages. These are what we came to call light weight and heavy weight teams, a reflection of how the team members felt about their team role.

As shown in this graphic, the lightweight team maintained the dominant functional organization, but sought to overlay it with more coordination. But members of such a team invariably thought of themselves as light weight because they knew that they did not control the majority of the resources needed for the project, nor could they make any decisions without the approval of the individual functions.

The heavyweight team on the other hand was co-located, and was given control over roughly two thirds of the resources needed for the project. Furthermore, they were sufficiently senior that they could make many decisions without detailed functional reviews, and they had the clout to effectively negotiate with the functions when challenging issues arose. But they also operated in a manner consistent with the processes of the existing organization and did not try to become truly autonomous.

Let me now turn to the third phase of our research and highlight a few of the conclusions from this body of work and their implications. Perhaps one of the most compelling findings early on, was the power of selecting the right type of team for a platform development project. While we had already done work to understand the differences between the types of development teams, working with a doctoral student, Taka Fujimoto, my colleague Professor Kim Clark gathered data on over 30 platform development projects coming from the leading automotive companies in the world. Their results, published in the early 90's, brought to light some dramatic differences in performance.

Let me explain the three metrics used in this comparison. Time represents the length of the project timeline from the start of a fully resourced project to the launch of the new product in the market place. Resources represent the number of technical and engineering hours in millions applied to that project. And quality represents the evaluations given by customers in response to the surveys that J.D. Powers does of all new car buyers in the U.S., Europe and Japan.

As shown in this summary chart, those development teams who organized around an integrated heavyweight team model completed their next generation platform projects in two thirds the time and one half the resources as those using a lightweight functional organization. In addition, the resulting quality of the products developed by these heavyweight teams, as rated by customers, was 50% higher than that experienced by buyers of new car platforms developed by lightweight functional teams.

This explains much about the competitive changes we've seen in the global auto industry over the past 20 years. The fastest growing, most profitable auto company throughout this period has been Toyota. And throughout, they have used heavyweight teams on all their next generation product development efforts. Today, they can develop such a new car platform in as short as two years, using even fewer resources and with the same high quality. No wonder they are now the number two auto maker in the world and before long will be number one. When Toyota entered the auto industry in the late fifties, few would have thought that possible.

Let me give you a second example from the world of computers and electronics. Back in the early 1980's, I started doing product development research on a young upstart company named Apple. The first platform project we studied was the LISA computer with its derivative product, the Macintosh. This project was the first platform for a new product family and for all intents and purposes, the team leader of this project was the then CEO, Steve Jobs. The team structure was that of an autonomous team and while it launched Apple on a whole new trajectory, they still had much to learn.

By the early nineties many were predicting the demise and disappearance of Apple as a computer company. Finally, Steve Jobs was brought back, having learned much about heavyweight teams and many of the other tools related to successful innovation and product development. As a result, the Apple we know today has nine major product families-- three under the iPod name (the shuffle, the nano and the standard iPod), five under the Mac name (MacBook, MacBook Pro, Mac mini, iMac and MacPro) and one under the recently added iPhone name.

While many lessons can be drawn from the results achieved by firms like Toyota and Apple, as well as from the research that my colleagues and I have worked on for these past few decades, let me just summarize three of

those:

1. Defining and structuring product families and their generations, and appropriately defining the platform for each subsequent generation can have a dramatic and sustained impact on the successful application of new technology and the creation of a continuing stream of innovative new products.
2. Developing the organizational capability and processes to form and lead integrated heavyweight teams on platform development projects can turn the promise of new product generations into customer pleasing products and services.
3. Sustaining and enhancing such new product development capabilities over an extended period of time can transform an industry and greatly enhance the customer appeal of such products.

I hope it is clear to all of you that I love the areas of new product development and innovation that I've been blessed to be a part of. And I have enjoyed working with many wonderful colleagues on these endeavors. My years of research and systematic study have been filled with exciting and engaging discoveries and the opportunity to see those adopted and built upon by many others.

Not surprisingly, I have come to see many of the challenges of higher education, through the lens of innovation and product development. So let me, if I might, spend the last few minutes on some of the challenges we face and how the findings and lessons of innovation and product development might shed light on those. These are not conclusions, but rather "food for thought."

The first of these challenges follows directly from the ever expanding knowledge base in all the fields and disciplines with which we are concerned. Much of this is the result of the inspired and inspiring efforts of the researchers located within Universities around the globe. Almost daily we hear of the discovery and refinement of new and exciting knowledge which deepens our understanding of the physical and social sciences and expands the horizons of artistic endeavor. But with this progress comes greater and greater specialization within the disciplines and the challenge of keeping up to date both individually and collectively.

A second challenge is that of the marketplace for our graduates-- the organizations and businesses whose very existence depends on hiring graduates who are prepared to participate in practice, who can add to the effectiveness of their organization from day one, and who can continue to build on a solid educational foundation through constant, ongoing learning. I believe that this is one of the reasons that those involved in the accreditation of institutions such as ours are so focused on outcomes and their assessment. Like the market for our students, they want to know what we are trying to accomplish and how well are we doing it.

While these two challenges have major implications for departments and their faculties, they also have major implications for both general education courses as well as for upper division work in a major. Part of the challenge arises because the dominant organization in universities is functional, and yet the market wants graduates who can bring integrated knowledge to bear on a diverse set of conditions and provide solutions to complex problems. The core strength of the university -- deep functional expertise in multiple disciplines -- appears to work against the integration that potential employers seek.

To further complement these efforts to provide breadth and relevance to practice, increasingly undergraduates are encouraged to pursue an internship and to find on-campus employment opportunities -- whether in a science lab, a media studio, or an audit group -- where they can apply what is being learned in class and further focus and develop their capabilities. Indeed few potential employees are interested in graduates who fail to understand the practical application of the things they have studied and lack the basic tools needed to contribute to ongoing

organizational tasks and real time problem solving. While our internship efforts and our on-campus and PCC job opportunities are helping in this regard, I think we all understand that much more needs to be done.

And let me just mention a third challenge that undergraduate programs are wrestling with, and that is the question of pedagogy and how to make teaching and learning more engaging and relevant to students. Through a variety of new technologies and innovations, the world is discovering new ways of communicating, learning and working together. Fast disappearing is the day of the traditional education model of a learned professor lecturing to a class with the dominant information flow being one way.

These are just a few of the challenges that undergraduate institutions, like BYU-Hawaii face -- but we have the distinct advantage and blessing of being in an environment where we can not only rely on the capable professional work going on around us, but we can literally call on the powers of Heaven for help. As Elder Neal A. Maxwell has stated,

"Only an excellent university can really help the Church much. Mediocrity won't do, either academically or spiritually. A unique church desires a unique university!"

I do not have the answers to these three areas of challenge that I've just outlined. And while I do believe that much of what has been learned in recent decades regarding innovation and the development of new products and services may be useful, I also believe that through the power of the Holy Ghost, the Lord will inspire us and direct us so that we can achieve the mission and prophetic promises made concerning this great University. We can be both excellent and distinctive in doing this work. In fact, given our scale and resources, I firmly believe the only way we can accomplish this is by integrating the best of secular learning with the best of Spiritual learning and insight.

As we live and learn with increased faith and obedience, great blessings will be ours both individually and collectively. I know the Lord loves us. We are His children, heirs to all that he has -- including all knowledge, all power, and all wisdom. I so testify in the name of creator of this world and all that is in it, even Jesus Christ, amen.