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Business Navigation and Real World Awareness

Modern aviation is the complete realization of Real World Awareness. As a passenger, when you board a flight from Frankfurt to New York, your thoughts may roam to which movie will be played. But, in the cockpit, the pilot and copilot are in an intense conversation with a computer that is making sure that all the sensors that keep track of the plane's engines, speed, altitude, radar, GPS, and fuel levels are in working order. The pilots are also checking higher-order functions that use these sensors in intelligent ways. The autopilot, the ground-proximity warning system, the landing system, the communications system, and the navigation systems are all run through diagnostic routines. As the plane takes off, sensors on the engines are taking dozens of readings that will later be sent via satellite to a central computer that is monitoring the operation of the engine and looking for patterns that indicate problems or inefficiencies. While you are wondering whether your favorite Chardonnay will be available with dinner, the pilot is managing and monitoring all these automated systems and waiting for them to indicate any problems so that the right response can be executed.

This modern flight is the essence of the concept of Real World Awareness, which is the topic of this book. Data from sensors provide information about the real world. Automated systems use that data to

carry out complicated tasks. Advanced data analysis looks for patterns in the future. The pilot is in the center of it all, monitoring, managing, and handling exceptional cases. All this is at the service of the customer, who, although unaware of the means, knows that the flight is safe, well managed, and available for an attractive price. This finely tuned machine did not start out this way, but was the result of decades of evolution.

In the early days of aviation, well into the 1930s, flying a plane was an art that required skill and intuition, not to mention a serious dose of bravery. The cockpit was sparse, with a joystick, a couple of levers here and there, and a good view. Speedometers and altimeters were all in the future then, and pilots flew planes by feeling based on experience. This method was called *flying by the seat of your pants* because the pilot's "rear end" was literally one of the most important sensors! Pilots wore thin clothing and sat on seats with little padding in order to better sense the vibrations of the plane. Experienced pilots would know what sort of vibrations were okay and which bumps and jiggles indicated a problem. Figure 1.1 shows the cockpit that Charles Lindbergh faced when he crossed the Atlantic in 1927.

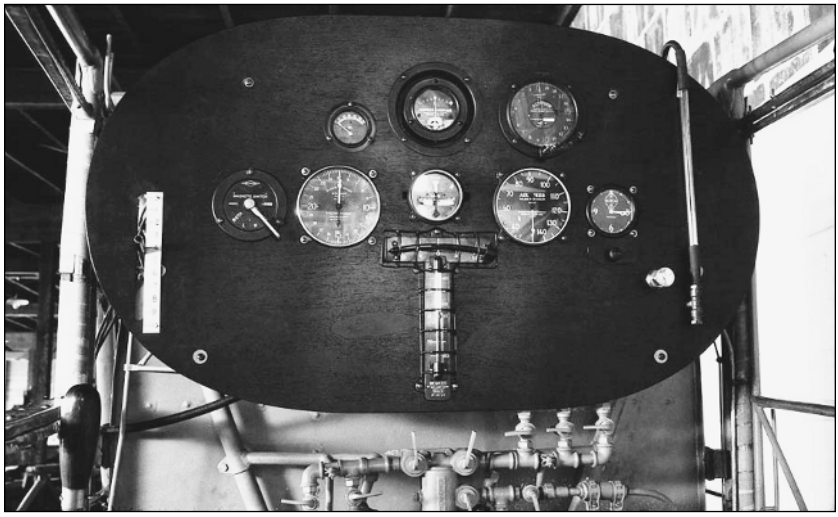


Figure 1.1. Cockpit from the *Spirit of St. Louis*

As aviation technology progressed, more instruments were added to the cockpit to provide the sort of information that achieves Real World Awareness. At first, air-speed indicators, altimeters, and compasses appeared, followed eventually by radios, radar, and primitive flight-warning computers that sensed dangerous conditions. Figure 1.2 shows the cockpit of a DC-3, which added a significant number of instruments. The pilot was joined by a copilot, navigator, radio officer, and flight engineer, who was responsible for maintaining the machinery while flying. As technology advanced, computers changed cockpits dramatically, sometimes in ways initially resisted by pilots. Advanced navigation systems, fly-by-wire systems, and autopilots were all accepted after a struggle, which included fights over the elimination of the radio officer, navigator, and then the flight engineer, which gave aviation the modern two-person cockpit, also known as the "glass cockpit."

Figure 1.2. Cockpit from a DC-3

In today's planes, you find advanced navigation systems that have maps of the geography of the entire planet. Figure 1.3 shows you the glass cockpit of the Airbus 300 series, which was the first in a long line of computerized designs that skeptical pilots derisively called "the electronic pig." Autopilots have evolved to automate most of the tasks of flying a plane, including landing. Pilots no longer hold the plane on course with their hands, but, rather, manage the information presented to them by the computers, which warn pilots of upcoming threats and prevent them from executing maneuvers that would lead beyond the limits of the safe flight envelope. In the most advanced high-performance aircraft that fly at incredible speeds and have a minute tolerance for error, humans cannot even fly the plane. High-performance computers are required to perform most of the tasks of adjusting flight controls, such as flaps, at speeds of Mach 2 or higher.

Figure 1.3. Glass cockpit from an Airbus A300

A transformation in business is now under way that runs parallel to the evolution of aviation technology. Despite the application of advanced technology and business systems, too many business executives still fly their organizations by the seats of their pants. It is not because the business systems do not work, but rather because, until quite recently, even the most modern systems were still based on *assumptions,* not on real-time data about where goods are located, what state they are in, and other data that could provide an accurate map of reality. The information in these systems is only as accurate as the last inventory check or data entry into the system. Real-time essentially meant "as soon as someone let the computer know!" Without *real* real-time data, businesses face uncertainty. Business-oriented Real World Awareness techniques, such as Radio Frequency IDentification, are dramatically reducing the cost of automatically and instantly acquiring accurate information about almost every aspect of a business. The gap between the state of the virtual world in business systems and that of the real world, which is being managed, can be reduced dramatically. When this happens, immense value can be created by increasing efficiency, expanding automation, or opening the door to new lines of business. Like a pilot in a modern plane, with Real World Awareness, executives have a new job. Automated systems can sense the exact state of the real world and respond appropriately. When exceptional conditions arise, both pilots and executives have a wealth of information to help determine a response.

We can still hear the echo of the starting gun in the race to apply Real World Awareness. There is much more to learn than is now known about how to apply this powerful technique. What this book aims to do is to take a snapshot of where we are now and explain a coherent way of thinking about the important issues because the stakes in this race are incredibly high. Companies must figure it out for themselves. The winners will be those who learn how to adapt their way of doing business to the new possibilities that Real World Awareness brings.

REAL WORLD AWARENESS IN AVIATION

Flying by the seat of the pants is really not that bad of an idea, if you have no other choice. Pilots took off and landed, navigated by compasses

or points on land, and got from here to there just fine. Good pilots could tell what was going on as their planes rumbled along, and many impressive feats of aviation were achieved.

But, although flying by the seat of the pants was an admirable skill, it was far from a well-defined, scientific process and did not lend itself to logical analysis, incremental and standardized improvement, or the development of safety guidelines and best practices. It was a matter of people doing the best they could with the available technology and experience. When more modern technology progressively arrived, aviation changed drastically.

The message for a Real World Aware business:

> Flying by the seat of your pants is acceptable only when you have no other option.

Instruments and Automation

The arrival of instruments to determine a plane's speed and altitude, its primitive weather measurements, and the performance of the engine changed flying from an intuitive skill to a process that was far more accurately defined and predictable. The speed at which a plane should be traveling at take-off and landing could be clearly specified. The proper readings of oil pressure, coolant temperature, and other parameters and indicators of stress on the engine could be easily documented. It didn't take long for the work of flying a plane to be expanded from one brave individual to a team designed to minimize risk.

As larger planes developed with multiple engines, a copilot joined the pilot to provide safety through redundancy. A flight engineer joined the crew to closely monitor the increasing amount of machinery and electronics on the plane. A navigator was also introduced to perform all the calculations that were required, because more primitive forms of navigation no longer worked for long flights during the day or night or at high altitudes. Radio officers were introduced to operate communications equipment on-board since early long-range communications were transmitted through Morse Code.

The number of instruments on the plane quickly ballooned and left the flight engineer with hundreds of points of data to keep track of as

the plane flew along. The flight engineer's job and the crew's task of monitoring were made easier by an automatic warning system, which was an early example of today's automated computer analysis system, the flight-warning computer. The flight-warning computer was programmed to monitor many key indicators on the plane and to emit a warning alert whenever certain thresholds were exceeded. This system provided assistance to the flight engineer and crew and served as a fail-safe device in case certain problems were missed. As the number of instruments on planes grew larger, the job of the flight engineer and crew became impossible without automation that analyzed values from hundreds of sensors and provided guidance to the flight engineer and crew about how to conduct analysis during the flight to ensure safety.

The message for a Real World Aware business:

> As the number of sources and the quantity of information grow, analysis must be automated.

Process Changes in the Cockpit

The flight-warning computer was just the beginning. Planes became much more complex. Jet engines, pressurized cabins, high-altitude flights, and radar all came with new technology that at first required care and special handling by the flight engineer and navigator, but eventually became highly integrated through automation.

Navigation was the first system to change dramatically. Even in the late 1970s, navigation still required the use of some ancient methods. On transcontinental flights, navigators would use a sextant to observe the stars through special slots in the ceiling of the cockpit. But then navigation computers arrived that used a variety of methods, and eventually global positioning systems, to completely automate navigation and provide a real-time view of the position of the plane and any deviation from the planned course. When these systems were introduced, reaction from pilots and navigators ranged from the suspicious to the downright hostile. On some airlines, even after the systems were introduced and in use, pilots and navigators refused to use them. Especially on flights that crossed the North Pole, pilots were afraid that the systems wouldn't work in the strange polar magnetic environment.

As it turned out, after a period of struggle, during which navigators continued to fly as part of the crew and most often did nothing, the automated navigation systems were finally accepted and the flight crew was reduced to three people: the pilot, copilot, and flight engineer. The navigator was eliminated. The radio officer was also displaced from the cockpit, as modernized telecommunications equipment simplified operations by pilots.

Automation quickly overtook the flight engineer as well, as new cockpits were introduced to allow the pilot and copilot to monitor and conduct operations with a variety of systems that automated the analysis of the readings coming from hundreds, and eventually thousands, of sensors all over the plane.

These developments hold two messages for a Real World Aware business:

- More information at first improves the current way of doing things and then creates completely new ones.
- Some changes may not be well received.

Fly by Wire

Aviation is inherently risky, which leads to engineering practices that emphasize redundancy. Components that may appear only once in a car may be replicated three or four times in an airplane. When one component fails, another takes over. If that one then fails, another is waiting, and so on. This system reduces the risk from the expected failure of components to the degree that pilots have time to land the plane before any catastrophic failure occurs.

As the number of sensors on a plane grew and the size of a plane grew, the number of cables connecting sensors to electronics grew even faster. This growth became a problem for reliability because many thousands of cables had to be connected properly, and for weight as the length and number of the cables added up to a significant load.

Airbus pioneered a solution, named *fly by wire.* This architecture replaced the thousands of electromechanical connections between the sensors and instruments and control mechanism in the cockpit with an electronic bus, or hub-and-spoke, design that could carry all the data from the multitude of sensors to the computers in the cockpit. This bus was similar to a superhighway for data that was used by all the sensors. This architecture replaced the complexity and heavy weight of thousands of wires with a much smaller and compact set of cables for the

bus. Each sensor connected to the bus sent and received data from the cockpit.

One effect of this solution was an increase in standardization among sensors, which then all had to be constructed to use the bus architecture. Airbus took another leap forward in the standardization of cockpits in its A300 series of planes, which were built to a standardized design. Almost all planes in the A300 series, and many of its successors, use the same design for the instrumentation, display, and controls in the cockpit so that a pilot can learn to fly another plane in the series after only a couple of days of training. Some other aircraft manufacturers create new cockpit designs for each model, which means that pilots trained on one model may need as many as three months of training to fly another.

The message for a Real World Aware business from these developments:

- More sensors demand better connectivity.
- More sensors make standardization even more vital.

The Pilot Redefined

Automation continued to surround the pilot. Ground-proximity warning systems would activate aural alarm signals if the plane was closing fast on terrain or a mountain or any obstacle so that the pilot could return to a safe altitude. The autopilot function, which maintains course and height according to a flight plan and automatically adjusts the direction and speed of an aircraft, became even more powerful. Key elements of a pilot's job, such as landing the plane, became highly automated so that the pilot could, under normal conditions, play the role of a highly intelligent failsafe device who would meticulously monitor everything and take over in case automated systems did not function properly or could not handle difficult conditions.

This increase in automation has profoundly changed the role of the pilot. No longer are the physical movements of the pilot directing the plane for most of the flight. The pilot has become an executive of the aircraft, a manager who defines the task that the automated systems should carry out and then manages any problems or exceptional conditions that arise. Pilots now have to understand the basic mechanics of the airplane, the control techniques with or without automation, and the operation of the automated systems controlling the plane so that they can be properly programmed. When problems occur, the pilot now resorts to the use of advanced diagnostic systems that provide insight

and alternative corrective actions to handle what is happening on the plane. The entire suite of automation helps the pilot to visualize, by using graphics, the entire spectrum of operations of the aircraft.

The message of this transformation for a Real World Aware business:

Increased automation leads to management by exception and insight.

New Possibilities for Aviation

The discussion in this chapter has led to the two-person operation of a highly automated cockpit, as summarized in Figure 1.4. Instruments sense the state of the aircraft. Technology such as the flight-warning computer automates the analysis of the sensors. The fly-by-wire system provides connectivity between the sensors and the response mechanisms that automate complex processes such as navigation or, in the case of the autopilot, entirely change the way the plane is flown.

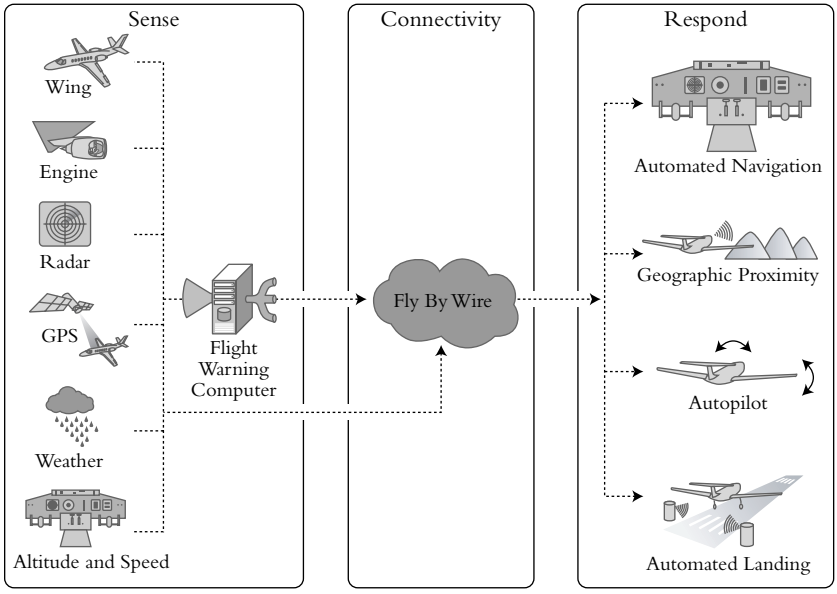


Figure 1.4. Real World Awareness in Aviation

Much of the action in aviation now is focused on reducing weight by replacing aluminum with much lighter carbon fiber in the construction of the fuselage and wings. Efforts are continuing to squeeze what may be the last 10 percent of efficiency from jet engines. The next wave of advances in automation is much more likely to affect the way planes interact with each other. The present tolerance for distance and height separation between planes is based on the capabilities of older-vintage planes. Scheduling algorithms, and the way that planes identify themselves and report on their conditions, can be improved. The amount of time spent in holding patterns over the Frankfurt airport each year, for example, accounts for enough fuel to make 200 trips to New York. This situation is a prime target for the next wave of automation.

The message for a Real World Aware business:

> Intelligent automated parts of a system can lead to dramatic new levels of efficiency, coordination, and collaboration in an adaptive business network.

Although aviation is a fascinating topic on its own, its history and complexity have served to present in this book, in an understandable way, the themes that companies will struggle with as Real World Awareness becomes an urgent concern. The next section examines how these themes will be addressed in the world of business.

APPLYING REAL WORLD AWARENESS TO BUSINESS

Real World Awareness applies to aviation, where the laws of physics rule in a fairly clear and straightforward manner. The world of business is more "fuzzy." The dynamics of markets, the complexities of organizational and human relationships, and the incessant pace of change make for a situation that is much less stable and a set of problems that is harder to solve. The fact is that in most businesses, there will always be some flying by the seat of the pants. The goal is to do as little of it as possible. Business executives need to make decisions based as much as possible on facts rather than on assumptions. The executives need to sense and respond to business conditions, make plans and execute them, and—most of all—learn from their experience.

Aviation is concerned with safety, and the goal of business is growth and long-term survival. In both cases, Real World Awareness is a requirement for optimal performance. In aviation, Real World Awareness allows pilots to fly safely at night, or into clouds, knowing whether a hailstorm or just water vapor lies ahead. Optimal routes can be calculated to save fuel or to avoid close calls with other planes. The route to be flown and the terrain of the entire world are continuously displayed to every pilot in the cockpit. This display presents all ground features, and the prevailing weather conditions, through digital maps in ground-proximity computers.

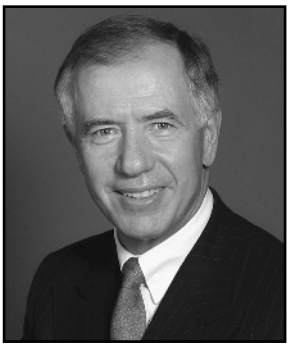
In business, Real World Awareness provides detailed information that transforms a vague seat-of-the-pants sense of what is going on in the huge variety of customer interactions from marketing, sales, and service—and the complex operations of a supply chain or manufacturing shop floor—into a precise real-time view of exactly what is happening in every important process. The availability of more information will transform business just as it has transformed aviation.

A similar pattern applies to the evolution of Real World Awareness in both aviation and business, as shown in Table 1.1. More information is collected, processes are improved and automated, and eventually new systems change the paradigm. Sensors provide information about the real world, which is then connected to automated mechanisms for analysis and response.

In aviation, these stages took decades as aviation engineers, aided by technological advances, improved the design and engineering for each successive model of aircraft. In business, the progress has been faster, less steady, and more lurching as companies have rushed to take advantage of mainframes, and then minicomputers, and then personal computers, and then client-server technology, and then applications ranging from spreadsheets to ERP systems. The Internet, of course, was the most dramatic recent driver of change.

For business, the arrival of affordable Real World Awareness technologies such as RFID, the wide availability of both wired and wireless networks, and the development of advanced systems for automation and analysis is now opening up a new world of opportunities.

Deutsche Lufthansa AG is one of the world's leading airlines. Alongside its core business of passenger and freight transport, Lufthansa offers its customers a number of specialized services related to air travel. More than 90,000 employees from 150 countries have made Lufthansa not only one of the world's leading aviation companies, but also an employer with a particularly international focus. Lufthansa is among Germany's 20 largest and most popular employers.



Juergen Weber

Chairman of the Board

Deutsche Lufthansa AG

Born in 1941, Juergen Weber joined Lufthansa in 1967 and moved through many different engineering and management positions on his way to the chairmanship of Lufthansa's executive board in 1991. During his long career, Juergen was instrumental in driving technical innovations in aircraft maintenance, for which he has received many awards. He also led Lufthansa through privatization and the creation of the Star Alliance. In June 2003, Juergen was elected chairman of Lufthansa's supervisory board.

Q&A with Juergen Weber, Chairman of the Board, Lufthansa AG:

Q: Aviation has pioneered the implementation of Real World Awareness. What is the next frontier for improvement in aviation?

A: We're approaching the end of the optimization curve of the "hardware" of flying, such as engines. It will be costly to push their efficiency any further. But a number of other great things can happen. One of the most promising areas is air traffic control and flight systems. The current procedures partially date back to the propeller era when navigation was done manually, with a precision of plus or minus 1 kilometer. Now, precision is very high, and computers can communicate with each other, which is not sufficiently exploited. Systems do not interact efficiently, and the result you get is holding circles, delays, and unnecessary fuel burn. Integrated management of processes will make sure that when you depart from Frankfurt your landing slot in New York JFK is already guaranteed, with strong winds perhaps as the only variable. This will reduce costs and improve safety and punctuality.

Q: You have spent much of your professional career on helping to set standards. Why are they so important?

A: Standards ensure the smooth running and safety of the airline industry. International Air Transport Association has taken a lot of care to standardize key components. If an airplane uses an automatic landing system in Frankfurt, it must be able to land with the same system in New York, in Singapore, and in Sydney as well.

When airplane cockpits differ in their layout, in the way switches and levers are deployed, it complicates the jobs of the crews when they progress from one type to the next. It places extra burdens on progression training tutorials.

Airbus has really gone a long way to implement a high degree of cockpit commonality. Ridiculed at the beginning by pilots, by experts, by technicians, but also by the competition, Airbus standardized cockpits and achieved a very big economic advantage and a safety advantage as well. When a pilot enters a new aircraft, the standardized cockpit means he does not have to be retrained.

Q: What are some applications of Real World Awareness in air travel?

A: There are plans in the cargo area, for example, where containers with precious items need to be tracked.

The RFID technology could be of great help, for instance, in luggage tracking and identification systems. Hardly any day goes by without security delays. It's a familiar announcement when a captain has to tell his passengers: "Ladies and gentlemen, unfortunately, we cannot take off because we must unload a suitcase." Oftentimes, they want to unload one that is not on board at all. If you had some way to query the luggage in the hold and tell what was there, much time could be saved. But this is just the beginning. There are vast opportunities.

Q: How would you like to see the sort of Real World Awareness we see in aviation show up in business?

A: Today's pilot gets everything he needs in real time. That means that if the pilot makes an adjustment that might lead to an unsafe situation, the computer tells him: "Friend, I'm not doing that because, otherwise, you would get into a dangerous flight attitude."

Why can't we have the same sort of standards in business? It still takes too long for me until we get our weekly results, our monthly results, and then the result at the end of the year. We are not fast enough yet. We should really be able to relate results to decisions that have been made beforehand.

The analysis of the information also seems to start from scratch too often. Why can't we define a business envelope at all different levels of the company and have automated analysis tell us when we are nearing or exceeding limits – a kind of early warning device?

TABLE 1.1 STAGES OF EVOLUTION FOR REAL WORLD AWARENESS IN AVIATION AND BUSINESS

Stage of Evolution	Aviation	Business
Seat of the pants	"Rear end" serves as sensor.	Intuition and guesswork are used.
Better information through Real World Awareness	Basic instruments are used.	Real-time data replaces batch processing and nightly or weekly updates.
Process improvements through automated response and analysis	Navigation is automated.	Key processes, like vendor-managed inventory, are automated.
Business innovation through networked intelligent systems	Autopilot flies and lands the plane, and ground proximity warning systems provide alerts in case of problems.	Adaptive business networks coordinate activity across value chains; disruptive processes, like predictive maintenance, change paradigm.

The challenge for applying Real World Awareness to business is that millions, if not billions, of points of data could be collected. But not all information is created equal. Executives seeking to take advantage of Real World Awareness must first focus their attention on collecting the information that will make the most difference. This information can then improve the performance of existing business systems, pave the way for incremental improvements in process, and eventually lead to innovations that may reshape a company and open up entirely new lines of business.

Later chapters will answer the question "Why should any company seek to improve its business through Real World Awareness?" The rest of this chapter examines the three stages of evolution and their implications and shows you how the messages for business that surfaced in our analysis of aviation relate to each stage.

Better Information

Huge areas of a business that were formerly in the dark can now be monitored precisely. The following exercise can help determine where to start with information gathering:

1. On a blank piece of paper, write *Seat of the Pants* in one column. List in that column every area in which you must make decisions based on inadequate, inaccurate, or stale information.
2. In the second column, write *Real World Awareness,* and describe for each Seat of the Pants area the information needed to make better decisions.
3. Sort the list by priority of the business issues addressed.

This exercise is one oversimplified way to generate a to-do list for the initial instrumentation of your business. Many companies find that this burden has been taken off their hands because important partners have forced the issue and mandated the use of Real World Awareness, in most cases, RFID technology.

Competition is also forcing the issue in many industries. Most leading firms in manufacturing, retail, and high-tech already have heavy investments in Real World Awareness technologies.

The driver for these investments is the absolute faith these companies have that more information will lead to business value. In other words, they have heard the first message we discussed earlier ("Flying by the seat of your pants is acceptable only when you have no other option") and decided that they have another option. The first phase in which better information is required begins at most companies with a similar leap of faith.

What happens is that an infrastructure investment is required that then yields real-time information—about inventory at a warehouse, for example, or work-in-progress information on a shop floor—that is used to replace stale information in existing ERP or SCM business systems.

But this stage is quickly followed by attempts to address three more messages, contained in this stage for aviation:

- As the number of sources and quantity of information grow, analysis must be automated.
- More sensors demand better connectivity.
- More sensors make standardization even more vital.

In creating the infrastructure to gather more information, companies generally expand their use of wireless networks, develop or adopt

interoperability standards, and enhance their capabilities for both ad hoc and automated analysis of the increased trove of information.

Soon, this information leads to new ideas about how to improve operations.

Process Improvements

More information almost invariably leads to opportunities to optimize current business processes and expand automation, if those opportunities are supported by technology that analyzes and manages the data to help execute a timely response. A steady stream of updates from a warehouse management system that tracks inventory at a retailer's distribution center allows the manufacturer of products to automatically send shipments to keep inventory at proper levels. When this technique, called *vendor-managed inventory,* is working properly, it serves to reduce inventory levels *and* reduce stock-outs, in which a retailer runs out of a product that consumers want to buy.

Real World Awareness allows an end-to-end view of business processes that span across companies. Applications of Real World Awareness increase security and reduce theft. Reaction times to events become faster. Consumer behavior can be closely tracked and used to transform value chains into a demand-pull model rather than a supply-push inventory model. Such developments echo the following message from aviation: "More information at first improves the current way of doing things and then creates completely new ones."

Gradually, the level of automation in business relationships increases to the point where the following message from aviation applies: "Increased automation leads to management by exception and insight." This statement means that processes that people had control of are now running without human intervention, which sometimes creates a situation that confirms the message "Some changes may not be well received."

Business Innovation

Although efficiency and optimization are a key focus, at every stage of this transformation new business opportunities may arise. Better information and process improvements often are part of the process of developing a deeper understanding of a business and can easily lead to new offers to customers or different ways of pricing. But the most dramatic

form of transformation comes from the last message from aviation: "Intelligent automated parts of a system can lead to dramatic new levels of efficiency, coordination, and collaboration in an adaptive business network."

In retailing, Metro Group has pioneered the introduction of Real World Awareness into stores to change the shopping experience to make it more dynamic. Products with RFID tags can interact with shelves, shopping carts, information displays, cash registers, and scales all equipped with readers that can sense the products and react. Procter & Gamble is using Real World Awareness technology to pursue its vision of a consumer-driven supply network, in which timely information is used to pull, in effect, products through the supply chain rather than use planning algorithms to push products to where forecasts say that they might be needed. In aircraft maintenance, sensors on jet engines are being used to sense the operation of the engines and predict when they need maintenance or replacement of parts.

Although better information and process improvements can bring great value, business innovation based on the power of Real World Awareness is the path to the largest benefits. These examples are only a sample of those explained in more detail in later chapters of how more information, advanced analysis, and intelligent components can change the paradigm for a business. Figure 1.5 shows you the broad structure of how Real World Awareness applies to business.

Two more topics will complete our survey of Real World Awareness in business: the architectural elements that are part of the solution and the management challenges involved in making everything work.

Architectural Elements

Just as the basic structure of planes and the processes used to fly them changed as more Real World Awareness was introduced, in business the design of business processes and the relationships between companies and IT infrastructure will also change dramatically.

Business systems that were built to use stale information or data describing fuzzy aggregates will have to change. New algorithms are required in order to take advantage of more timely and accurate data. A richer virtual model of the world must be created. Business systems are supplemented by automation distributed in intelligent components that gather information, report on significant events, and otherwise act independently.

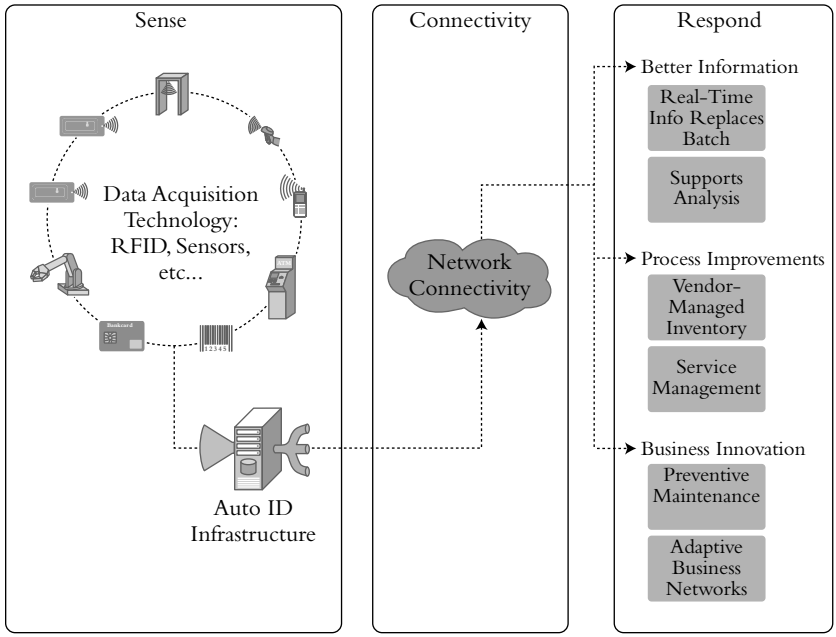


Figure 1.5. Real World Awareness in Business

For business processes, automation extends to cover a larger portion of a business and the business itself may be participating in a large adaptive business network.

Management Challenges

Managing the application of Real World Awareness requires a constant search for many different sorts of threats to success. One of the barriers covered in Chapter 5, which covers issues related to the implementation of Real World Awareness, is the difficulty of managing change. Pilots initially were skeptical and sometimes rejected certain advances, and it is likely that many companies will face similar resistance as a cultural shift toward management by exception and insight takes place. New skills will be required, and older skills may indeed be replaced. Executives will also likely have to beef up their analytical abilities to understand and take advantage of the abundance of information about previously unmonitored activities.

Perhaps the largest management challenge is one of vision. Some companies will be the leaders in Real World Awareness and will become

the masters of new forms of adaptive business networks and other new structures for industries. Other companies will succeed as master participants in networks and become preferred providers. Still other companies will scramble to catch up or even survive.

This chapter has taken a look at how Real World Awareness has changed the fundamental nature of aviation and how it is beginning to transform business in the same way. Aviation has become safer, cheaper, and more reliable as Real World Awareness has been implemented. Businesses that are still flying by the seat of their pants now have a choice to make. Will continuing this way work, or will a clearer picture of the real world be required in order to survive and win?

The goal of this book is simple: to help executives and managers understand how to think about the changes coming down the road. This is not primarily a book about RFID technology—it is a book about Real World Awareness. We are just at the beginning of innovation in this area, and new technology will arrive at a steady pace. What will be more stable are the stages of change that Real World Awareness will follow. We hope that this book presents those stages in a useful way so that you and your company can thrive.