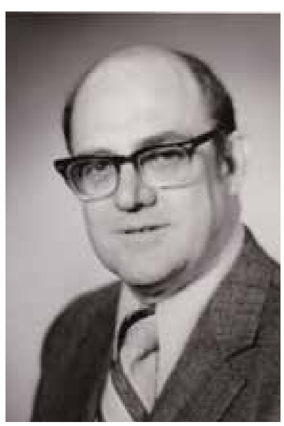
Key industry professionals engage with one another on the exhibit hall floor. All photos courtesy of OTC unless otherwise noted.

Deeper Through the Decades, An Interview with Carl Wickizer

Edited by Joseph A. Pratt

The Offshore Technology Conference has been a central forum for sharing information on the extraordinary technical changes that have allowed the offshore industry to expand its operations into deeper waters and harsher environments. Much of the early development of deepwater technologies can be seen through the career of Carl Wickizer (1931-2007), who went to work for Shell Exploration and Production in 1954 after graduating from Oklahoma State University with a civil engineering degree. In his job interview, they talked at length about the emphasis Shell placed on offshore oil as it looked to the future. Engineers were working in the lab and in the field to apply what was being done on land and in the marshes to the open Gulf of Mexico, leading Shell to recruit people with Wickizer's background in structural engineering offshore.



Carl Wickizer. Photo courtesy of Brad Wickizer.

Wickizer spent two years in the Army and returned to Shell, where he worked for several years in South Louisiana marsh fields, which included onshore marine operations. He moved up to supervisory positions in production engineering, drilling, production facilities, design, and computer-automated control systems for the oil field, with increasing exposure to the open Gulf of Mexico through economic studies.

In 1973, Wickizer received his first real assignment in the Gulf as a project manager for a pilot subsea system development program aimed at the deepwater of the future. He spent the next twenty years "engineering, researching, testing, and applying deepwater technology," working as a supervisor, engineering manager, technology manager, and research manager before being named projects manager for all of Shell's deepwater projects in the Gulf of Mexico.

Carl Wickizer worked for Shell almost forty years until his retirement in 1993. Bruce Beauboeuf, currently managing editor of *Offshore* magazine, interviewed Wickizer at One Shell Plaza in Houston, Texas, on November 21, 1997. A portion of that interview follows, tracing many of the technological breakthroughs in the industry across five decades.[1]

A robotic product demonstration draws a crowd at OTC in the 1970s.

Evolution of Seismic Mapping and Drilling Rigs

I have seen a lot of changes from the time I first started working in the Gulf of Mexico until now. The exploration phase, of course, starts out with doing seismic mapping, which is the primary tool offshore. It is really about the only significant tool once you get past the basic geology of understanding where traps might lie, the kinds of structure you are looking for, and the kinds of source rock that may exist. A lot of basic chemistry and geology goes into thinking before you start doing seismic mapping.…As you get into deeper water, that changes from a small boat doing single lines to what is now done with the very large boats and a lot of streamers treading for miles across the Gulf of Mexico, shooting off air pulses that reverberate through the rocks and are echoed back up to receivers that are trailed by the boats and captured on massive computer systems that record billions and billions of bits of data. And then they are all massaged and analyzed and turned into maps that show subsurface structure and, in some cases, even so-called bright spots which indicate hydrocarbon probability. This has changed dramatically in the last ten years [prior to 1997].

Bright spot is not a Shell invention. It is simply a seismic technique which…amplifies reflections from oil in a certain way, allowing you to suspect, with more probability, that there is oil in a particular place. We were on the forefront of

For the first two years, OTC was held at the Albert Thomas Convention Center located in downtown Houston, Texas. This Totally Enclosed, Motor Propelled, Survival Craft, known as a TEMPSC, was on display at OTC in 1971.

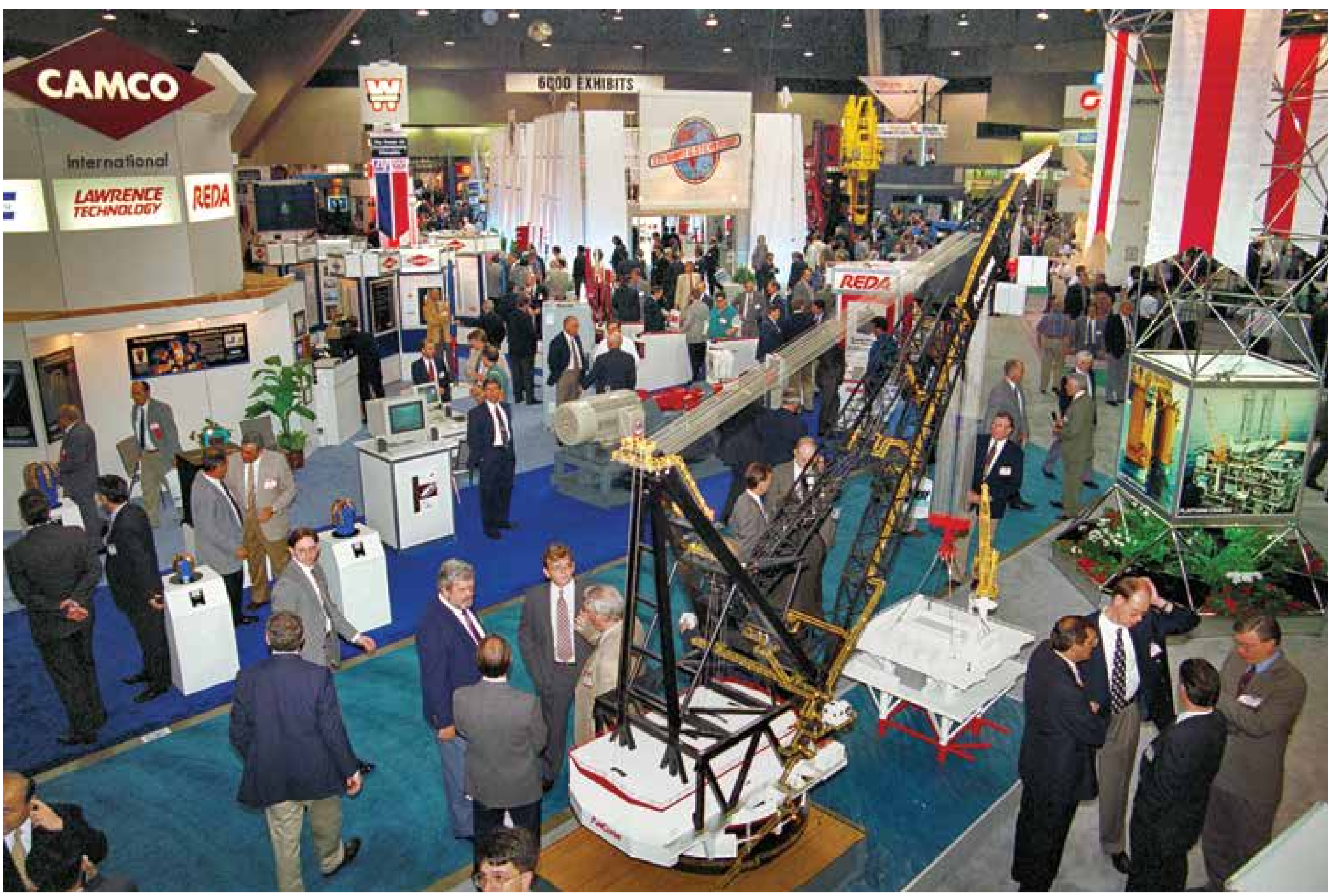
Carl Wickizer worked in the offshore industry for almost forty years and was named Shell's projects manager for all of its deepwater projects in the Gulf of Mexico. Photo courtesy of Brad Wickizer.

developing that technology, but it was being developed by the entire industry all at the same time. Shell Exploration had a lot to do with understanding the bright spot technology and bringing it along, but there were a lot of other companies involved. But it is a technique that is selective; it is effective in a particular area of the world.…The bright spot technology that we developed in the Gulf of Mexico worked extremely well for us there, but could not necessarily be extrapolated to other areas of the world. Bright spot technology was being developed in the 1970s, and in the 1980s, we certainly used it extensively.

In shallower water we would go out and do a lot of very simple mapping and then go buy a few leases based on those maps. In the deepwater we are in today [Editor's note: Here and elsewhere in the interview, "today" refers to the late 1990s.] however, the technique is to do a lot of very detailed mapping because the cost of drilling an exploratory well is so high. You essentially do detailed mapping of an entire area, buy all the leases that you can, or at least bid on them within the area, and then do even more detailed seismic mapping before you drill the first well. We spend a lot more time mapping and analyzing prior to drilling the first well out in the deep water because of the high cost of drilling.

Once you have massaged all that data, exploration tries to pinpoint the best place to drill a particular structure to get the first indication of its oil bearing and size. Then you pick a drilling rig suitable to do that kind of exploratory drilling. Of course, in the old days in the very shallow water, it was a barge-mounted rig that just sat on the ocean floor in, say,

In 1985, OTC rebuilt the exhibition and conference to reflect global activity.



ten feet of water. As you moved that into deeper water, it became the jack-up rig, which initially could work in up to 100 feet of water and then later, up to 200, and finally up to 300 or even 450 feet of water. Deeper water required different types of mobile rigs, including floating drilling operations and either semi-submersible or shipshape rigs that can now drill in up to about 7,500 feet of water. Ongoing research and development could take it even deeper to 10,000 feet and beyond.

Bruce Collipp (of Shell) was, more or less, the father of semi-submersible technology. It was extremely important because it gave us the capability to decouple the well on the ocean floor from the rig that was drilling the well, so we were not tied together by any legs. This made it possible to use a floating drilling operation to any water depth. This was a giant breakthrough in the ability to put the wellhead, the blowout preventer, and all these things associated with well safety and the ocean floor on a rig that could float on and float off, without any consequences, and the depth limitation was determined totally by things other than structure.

Soil borings were very important in jack-up rig deployment because you had to understand the foundation in which you were putting those legs in to hold the rig up, and that was very critical in the early days. Soil borings, as such, became a lot less critical in floating drilling operations. But the ability to map not only the surface of the ocean floor but the subsurface portions of the top 200 or 300 or 400 feet, is important to the floating drilling operation. You needed to know what you were getting into before you would penetrate the top part of the ocean, the soil. Drilled into shallow gas bubbles or shallow water flows or consolidated soils, for example, might allow your surface casing to collapse. That capability, with side-scan sonar and shallow seismic techniques, became quite important as we went into deeper and deeper water. In the 1980s, we spent a lot of research and development dollars on new technologies that became important in exploratory drilling on the rank wildcats scattered around the deep water.

In the early days when our seismic mapping techniques were not very refined, we were drilling deltaic sands, which had a way of being sort of hit-and-miss mapping. It was very important to drill a large number of exploratory wells or, at least what we would call delineation wells or confirmation wells, to try to understand the total reserve in place and its configuration before you set the platform….With today's technology, however, we have been able to replace a large number of wells with 3D seismic technology. Because we just cannot afford to drill a large number of wells to define all of these deepwater reservoirs, we have to be able to use very precise, 3D seismic technology, along with a minimum number of wells to define the reserve. That is happening in the deepwater today, and it is one of the real breakthroughs in deepwater production. Without that we would not yet be developing the deepwater.

The Economics of Offshore Technologies

A deepwater well in several thousand feet of water will cost upwards of ten million dollars. You just cannot afford to drill ten deepwater wells or more in order to find out if you want to develop it or not because it just drives up the marginal cost for every field. In contrast, you may spend three, four, five million dollars on 3D seismic, and then drill two wells or three wells maximum to define a developable reserve; [this] dramatically cuts down the marginal cost of finding the oil.

Carl Wickizer, center, controls a remotely operated underwater vehicle. Photo courtesy of Brad Wickizer.

The challenges that we met as we moved into deeper water reflected the technical challenges along with the economics of the company. Those technical challenges drove the speed with which we actually moved into the deep water and developed it….The problem was being able to go into the deeper water and withstand the ocean forces, the currents, the wind out there, the wave forces, the big waves, and then to solve the foundation problems, which became greater as you got into deeper water and had the higher forces and weaker soils. All of those problems were compounded by the fact that until we needed to go out in deeper water, nobody knew much about those forces or really understood exactly how they would impact a structure or how to build a structure under those conditions. So, they were starting from scratch. What are the forces of waves or wind on the structure? What does a hurricane really do to a large structure? It took a lot of years to understand how to design and what to design for, and then to actually convert that into a design in steel that we could go out and put in the ocean.…

Subsea was the most obvious innovation for deeper water because it could all be done on the ocean floor; it did not require anything that penetrated through all the waves and currents of the ocean and was sticking up above the ocean surface where the hurricane winds could get at it. So, it seemed like the obvious thing to do, and that is where the work began.

Subsea technology, however, had a lot of its own obstacles to overcome. First and foremost, if you are going to put a complex set of valves and controls on the ocean floor where you cannot see it and cannot get to it, it had to be very reliable and designed for that specific purpose. You had to recognize that although we could make dives in about 200 feet of water at that time, we were looking for something that would carry us beyond the 300 feet depth.

Well, that was stretching the limit of diving technology

A 1988 OTC Houston exhibitor showcases the company's latest deep sea diving suit.

also. Today, we can do working dives at one thousand feet, and the actual diving limit is about 1,500 feet. But back in the 1960s, the practical diving limit was only about 200-300 feet. We had to have things that could be done totally remotely to service subsea equipment in lieu of divers.…But how can you build systems totally remotely on the ocean floor which can be operated without manned intervention with the well head and all the controls and the valves down there? In 1961, we put in the first Gulf of Mexico remote underwater well. It was in about 100 feet of water, and it was a test bed designed to be totally installed and operated and maintained without intervention by man. As a matter of fact, it did require some divers because it was the first one.

About the same time on the West Coast, we were experimenting with MOBOTs, another approach that used remote underwater vehicles….Over the next 20 years, those techniques were continually refined, tested, expanded, changed, and new technologies were employed. By the 1980s and 1990s it was acceptable, doable technology. So, it becomes a matter not of can you do it, but how much does it cost and is it better than the alternatives?

The other option we started approaching in the same time frame was how to put something floating on the surface that could serve the same function as a fixed, bottom-supported platform….That took several directions: one was using semi-submersibles that were converted to house the control systems, quarters, and production facilities, tied to a subsea well, which was remote from the particular platform.

Other approaches we explored were tension legged platform, a floating platform that tied to a particular spot by tension legs tied to the ocean floor and spars….The real question gets to be, do you want it tied to subsea wells, which then produce through flexible lines back to that floating structure, which is moving around? Or do you want to support a drilling rig and Christmas trees on the platform that you can reenter using conventional equipment such as conventional workover units, pearl tubing units, wire line units mounted on the TLP? It becomes an economic trade-off for any given reservoir and water depth in deciding which one makes the most sense.

Because of the investment in hardware on the ocean floor and the high cost of drilling in deepwater, the cost of each individual subsea well becomes very high. In contrast, a well completed from a platform is much less expensive and you have a lot less expensive control and hardware on the ocean floor….Again, it is a basic trade-off….You have to look at the overlying cost of an entire field or area of development, to say, "What is the most economic way to develop this field?" So there is a difference in investment strategy. If you do not have much investment capital, you might opt to go with the subsea approach and a floating or a converted-semi approach, to minimize the up-front capital. But if you are not short of investment capital and you are looking more at optimization of cost and return over the next twenty years, then you might opt to go with a TLP because it might give you the best return on your money over that twenty-year period….

A universal problem that accompanies subsea wells is that all wells, when they produce, contain a lot of things which

Attendees were mesmerized by the Decca Survey technologies showcased at OTC 1979.

OTC Houston exhibitors display product models when actual products are physically impossible to bring into the NRG Center.

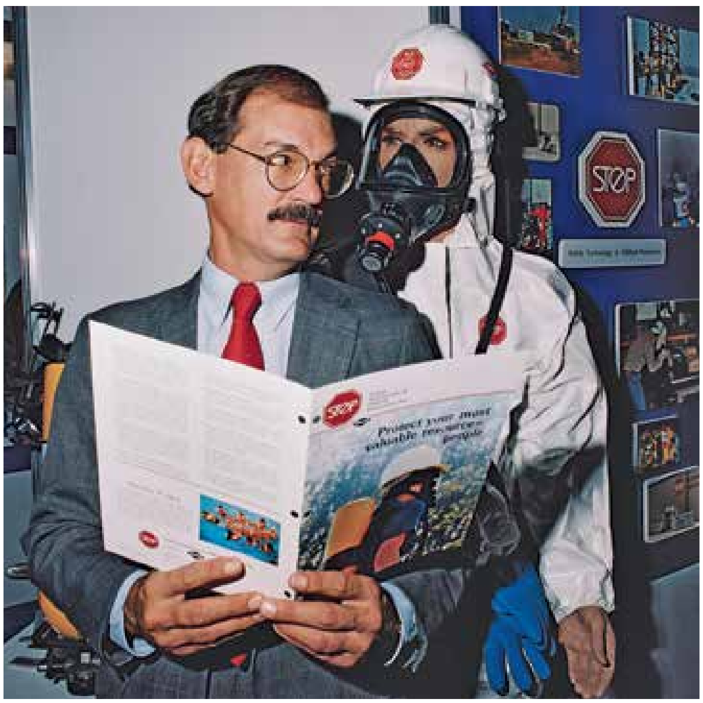
are not desirable. They produce paraffin. They produce wax. Sometimes they produce sand. If they have gas, they produce hydrates. All of these can plug very long flow lines. One of the challenges that is paramount is understanding which conditions you will face in any given subsea production situation, and you take care of it. Certainly, a lot has been done on insulating flow lines and on providing systems that circulate hot water. All of these are designed to maintain the temperature of the reservoir up to the surface and through a long distance on the ocean floor, which is really a big, cold sink that you have to deal with. And the techniques and technologies for dealing with that problem are just as complex and challenging as the mechanical one and how to deal with the higher pressures of external water columns.

I vividly recall a change in strategy that took place in 1980 and 1981. I was manager of marine systems engineering in our head office in Houston. We still were diligently working on design criteria, how you design tension leg platforms and all the technology for other floating systems. Somebody had decided that we should not be spending our time on that any longer because we probably were not ever going to make any money out of the deepwater. I was transferred out to our research lab to manage our production technology group out there, and we still had some ongoing work on the technology in the scientific area, but we sort of disbanded the engineering group I was managing….[T]hen, about a year or so later, I got a call asking if I would head up a study to see if and how we could drill on the East Coast in 7,000 feet of water. Our drilling experience at Shell then was limited to about 2,000 feet of water….Exploration said...“We are interested in bidding on some leases out there. Can we drill out there?” So, I put together a group, reached out to some of the people I had already assigned elsewhere and brought them back into the study group. And we did a little study. Could we drill? What would it take? If we found oil and gas, could we develop it? What was the timeframe? What might it cost? We spent several months doing this feasibility study.

Then in 1981, we went out and bought a bunch of deepwater leases in almost 7,000 feet of water. I reassembled the people I had dispersed and put together a team to go out and do that work. We did it over the next three-year period. Unfortunately, we did not make any discoveries out on the East Coast, but we developed capabilities that when we… were talking about leasing the large blocks in real deep water, we had a lot of confidence in our ability to do it and what it would take because we had that three years of experience. So, we really just moved the team back to working in the Gulf. We moved the drilling team, the drilling rigs, the engineers, and pursued the total exploration. “Let’s go buy it. We can drill it. We can produce it.” That is what we have been doing ever since….

It was not too long ago that experts in the industry were telling us there were no hydrocarbons worthwhile in the deepwater of the Gulf of Mexico. That was changed by the drill. The geology is different in deepwater Gulf than in shallow water Gulf. We understood delta deposits, which came from the rivers on the shelf. We did not understand turbidite deposits, which we were drilling in the deep Gulf. Many experts did not believe they would ever give up a lot of oil and gas. That is what an expert is: Somebody who makes a guess based on what he knows at the time.

When the federal government opened up the deepwater acreage and allowed us to go bid on it, there wasn't anything stopping us from going and exploring it. When we explored it, what did we find? We found marbles, we found pebbles, and we found all these glorious fields out there, which are extremely productive, much better than we have ever seen on the shelf.…But the key was that we had been doing the work, we had confidence that we knew how to do it, and we were not scared to do it. Until you explore it, who knows? Of course there are always disappointments. You don't ever strike 100% when you go exploring for oil.



Employee safety is not a laughing matter, but this photo taken in the early 1990s adds a bit of humor to the long days of OTC Houston.

In my mind, the biggest breakthrough and the biggest surprise of all going into the deep water in the Gulf of Mexico was the change and characteristic of the wells. For example, in the deltaic sands, an extremely good well produced 1,500 barrels a day; the first deepwater well at Auger, produced 13,000 barrels a day.…Back in the old days, a million barrels or a million-and-a-half barrels was considered a good well for the Gulf of Mexico. These deepwater wells we are completing out there now are producing ten times as well as what we ever saw before. You can have a huge reserve, but you still cannot produce that high a rate. So, it is not the huge reserves, but the fact that it takes a relatively few wells to develop those huge reserves. Without that breakthrough, I do not know whether we would be developing the deepwater or not.

Certainly we have had environmental-related problems and accidents.…Hurricanes have come through the Gulf of Mexico, and we had platforms that failed. Everybody had one or two. And over the years, as those platforms failed due to hurricanes we learned that our design criteria were not adequate. It is a matter of evolutionary learning: as you go farther out and you experience new things, you find out what you thought was true to start with and modify it a little bit.…And certainly, over the years we have changed our criteria. The API working with companies brought us together so we could change our criteria together.…We have sometimes embraced criteria that were too stringent, and we overdesigned. Other times, when the hurricane caused the platform to fail, we realized it was underdesigned. We certainly had costs of cleaning up the debris and abandoning platforms which were damaged, but to my memory we have not had any permanent environmental damages because of underdesign in the Gulf of Mexico. It is more than a case of costing ourselves money to clean up the wrecks of old platforms, which did not stand the test. Certainly, the wave heights we use in design have increased with time. The latest rage is to put in a global warming factor in the criteria to allow for the sea to rise next year, the next few years.

Historically, we did not do much trading of information with other companies. Along with other major companies, we considered that kind of information proprietary. I do not know whether it was right or wrong. In hindsight, we may have stifled the speed at which we developed a little bit. On the other hand, the competition may have actually done a good job in causing us to compete with one another. I cannot really assess that, but I do know that up until this last decade, all of the majors historically did not share much of their information with one another, even on structure design. We did go to OTCs and we did present some papers, but we kept stuff really close to the vest as to what we really were doing.

In the last ten years, as we got into the deepwater business, several things became very obvious. One was that we could not go out there (into deeper and deeper water) alone and do what needed to be done. It was just too expensive. The infrastructure was too complex. Even though we were "leading the charge," into deepwater, we really had to have partners to share the costs and the technologies; we had to have alliances with manufacturers who knew what we are doing and tried to work with us. Over a period of a few years, from 1988 to 1993 or 1994, there was a total change in our philosophy and that of the offshore industry. So, today, I think it is quite different. I think people are sharing with one another. They have to.

Throughout the Gulf of Mexico we had joint ventures but they were not true partnerships, where everyone is sharing in the thinking and the design and the development procedure. It was more of one company being the leader, being the operator, and making decisions and doing the work, and passing it by the joint venture partners for approval....

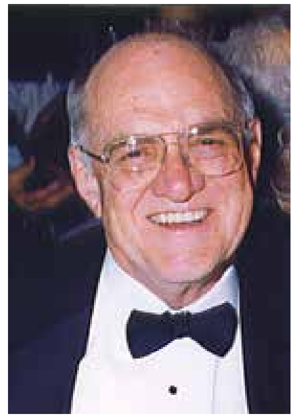
It changed overseas before it changed here. In the North Sea, because of the high risk and the high cost, they recognized before we did over here. In the 1970s and early 1980s joint ventures in the North Sea had to be true partnerships and the companies had to work together. They built joint teams of engineers, and that is the way they had to work, because of the high risk and the high cost. The Gulf of

Mexico did not pick up on that and follow it until later when we got into this ultra-deepwater stuff.

When the prices were going straight up in the 1970s, the economists were forecasting they would keep going to keep going. Not only Shell but the industry as a whole…had so much money to spend, and…we in industry made a whole hell of a lot of foolish investments. When the price came back down to something reasonable, which is basically a historic level, there was a period of years where I know we slowed down in investing. But the development went on. Our capital investment was dramatically slowed down while we [Shell] were reexamining what we could afford to invest in and how we could cover our costs. In the late 1980s and early 1990s, we cut our costs dramatically, as did everybody else. We also set some stringent new price guidelines for looking at new investments….One of the big arguments, back in the mid-1980s, was whether we should be in this deepwater or not. But, fortunately, we discovered big fields like "Bullwinkle" and "Auger." Even at reduced prices, we could afford to develop these. But there was a period of two or three years in there where our returns on investments were inadequate to give the company enough money to invest. I was actually out spending my time in the early 1990s trying to find partners to help us go forward on some projects that we could not fund internally.

Fortunately, we got through that period. We re-engineered the company. We downsized. We spun off properties. We cut operating costs through a lot of tough decisions. We did a whole lot of things that allowed us to become profitable again and get an acceptable return on our investment, which then gave us enough cash flow to invest in the things that we had on the books. That was a very difficult period though.

Mikael Leksell, from Siemens, speaks during the Topical Luncheon, "Digitalization Deployed: The Ivar Aasen Field Development Project: The Pursuit of an Ultra-low Manned Platform Pays Dividends in the North Sea."



Carl Wickizer.

The Future of Offshore and Offshore Technology

I think there will be more discoveries as we go deeper in the water in the next ten to twenty years. There will be continued expansion of subsea. There will be more TLPs. There will be more spars. There will be new innovations that we have not even talked about, some other systems. I think there is a right place for all those different kinds of systems, even though people look at them as competing. They are competing because each of them has a niche, which fits better than something else. We are going to continue to see all of them used in different places. There is no doubt in my mind there are more discoveries to be made in existing water depths and in deeper water depths.

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Where We Have Arrived: Current Deepwater Technology

Carl Wickizer's career spans a key period in offshore development, and he was in the thick of it. For "Nifty at Fifty," Jennifer Presley talked with OTC Chairman Wafik Beydoun who helped put the industry's technological advances – as illustrated by Wickizer's interview – in perspective by thinking of the industry's changes in Empire State Buildings instead of years.

"Fifty years ago, offshore E&P dealt with water depths that were neighboring 300 feet. That is about a quarter of the Empire State Building," Beydoun said. "Today, offshore E&P operations deal with water depths greater than 10,000 feet. That's about eight Empire State Buildings stacked on top of each other." This comparison demonstrates how technological innovations created the opportunity to drill deeper and farther away from the coast.

"In boldly going where no one has gone before, we really went far," Beydoun contended. "We have learned that these new resources, for them to be economical, need to be large or very productive as compared to an onshore well. Key technologies developed in the past 50 years, like geophysical imaging, ROVs, horizontal and multilateral drilling, subsea systems and station-keeping technologies, have enabled us to explore for and produce from these fields."[2]