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Time to Change[1]?

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This article looks at some of the current issues and problems in the pipeline industry, and how external influences, changes in our work place, and globalisation are effecting it. These changes are both essential and inevitable. The author puts forward evidence of the need for changes, and the new technologies and management approaches needed to achieve these changes

The goal of the paper is simple; to encourage organisational, contractual and managerial change in the pipeline industry, to allow it to be both modern and technology-lead.

1. INTRODUCTION

We hear a lot about the new economy and new pipeline technologies, and it is our expectations that they will make our industry both more efficient and successful. However, their success is critically dependent on how our industry is managed, staffed and financed, and therefore they will not be the only means that will cause change in our industry. We are like any other modern industry and we are undergoing massive commercial and managerial changes that will influence our future more so than technological change.

These changes are brought about by external influences such as the unstable oil prices and large oil companies merging. All executives and managers in the pipeline business should appreciate both the changes we are going through, as well as those expected in the future, in order to ensure both personal survival and a healthy pipeline industry.

This paper focuses on the 'change' we are seeing in our industry, and the change we can expect, and need. It briefly covers new technologies needed in the pipeline industry, but concentrates on the changes we can expect from the market, staff and management.

[1] This paper was first presented as the keynote paper at the Pipeline Technology Conference in Brugge, in May 2000. The author has subsequently updated and extended the text,

2. RECENT AND FUTURE CHANGES IN THE OIL AND GAS BUSINESS

The last 18 months have seen significant change in our industry. Two factors that have received the most publicity are:

a. mergers of the majors[2],
b. the price of oil.

These have direct effects on the new pipelines being built and the approach of operators to existing pipelines. In simple terms a low oil price means that fields are not viable, and hence pipelines are not built, and big company mergers cause unrest and uncertainty in those companies that make the decisions to build and operate the pipelines.

2.1 Mergers of the majors – pros and cons

Mergers are the modern way of growing a company, and the low oil price in 1998/9 lead to a drive for economy of scale (see Section 2.4); hence, the appeal of mergers (see Table 1, later). The 'market' reacts positively to them, and recent history shows that: small = stunted growth, and large = stability during market/domestic troubles.

The effects of the mergers on the pipeline business include:

a. change and uncertainty in staff,
b. change in culture, management, style of contracting, and communications,
c. merging of assets, and reduction in staffing,
d. delays and changes in decision making,
e. change in strategies, financial targets and budgets.

BP Amoco cut their worldwide exploration and production (E&P) capex by 40% in 1999, with exploration activities focussed on areas where large, low-cost resources can be found [1]. The UK North Sea is not a major figure in their E&P, although there is still a large commitment to the North Sea (see 3.6.2); the drivers here are improved productivity, financial performance and renewal, with technology and 'doing things different' seen as ways to achieve these goals [1].

Mergers should be viewed with caution. They produce new companies of vast size, with the economy of scale immediately producing higher profits, but shareholders now value the promise of growth ahead of both profit and size. This explains today's telecommunications market, where new, small companies who promise rapid growth, are valued above established giants who cannot grow (2, 3). A good example is the rise of Vodaphone, compared to the slow growth or decline of the former state-owned telecoms monopolies, British Telecom, France Telecom and Deutsche Telekom (3). Therefore, mergers of the oil majors may produce short term profits, but this type of business approach is not considered forward thinking (see Sections 2.7 and 3.6.3, later).

[2] **'Majors' is industry jargon for the largest oil companies in the world – see Table 1.**

2.2 The price of oil

The price of oil has seen wide variations over the past few years, Figure 1 [4]; the low prices in 1998/9 were initiated by the SE Asia financial crisis, but were primarily due to growth in supply and small reduction in demand [5].

World energy consumption in 1998 fell by 0.1% (the first decline since 1982), with oil consumption rising by only 0.1% (lowest increase in 5 years) and gas increasing by 1.3% (compared to an average of 2% over the past decade) [6].

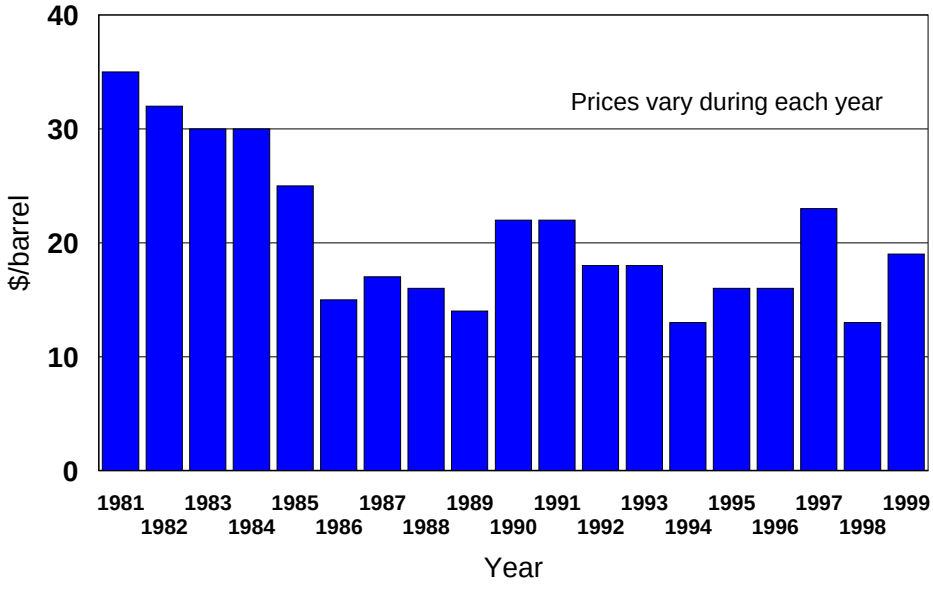


Fig. 1. Change in price of oil over 20 years.

The $10 barrel was with us at the end of 1998. This is a very low price; in the UK Sector of the North Sea it costs $11/barrel to develop existing fields ($13 if unsuccessful exploration is taken into account). New fields can now cost $10/barrel (cf. to $20 in 1980) because of 'CRINE' (Cost Reduction In The New Era), but again this is too expensive if the oil price is the same. Internationally, there is a general feeling that oil needs to have $6-8 development costs. Certainly Petrobas of Brazil are planning deepwater oil at $6 [5]. However, there was a rapid recovery in oil price in 1999, following the OPEC meeting in April, Figure 2, but the industry has been far quicker to react to the decline in 1998, than the incline of last year, with a resulting low number of, or delays in, new pipeline builds.

2000 has seen a huge increase in oil price, and the $30+ barrel became the norm.

2.3 Effect of oil price on the pipeline business

The oil price is crucial to new pipeline builds. The $10 barrel causes a recession, and clearly there will be too many players (operators, pipe suppliers, design houses, installers) in the industry at this price. However, $20 creates a healthy construction market; Statoil of Norway has said (1999) that in their sector 24 oil and gas fields could be developed at $15/barrel. At $12 this drops to 10 fields, and at $10 the number of fields is 8 [5].

The big oil and gas fields are no longer in the UK North Sea (but see Section 3.3 and 3.6.2); those left are small, and high cost to develop. The Middle East still offers the cheapest exploration and production costs (due to ease of development and size of fields), and deep water reserves offer good value (due to their vastness). In general, exploration and production costs are $4/bl in the Middle East, $8/bl in deepwater, and $12/bl in the North Sea.

Obviously, a $30+ barrel makes most developments attractive, but the huge investment required for new explorations, and the long lead times to bring oil on line (over 10 years), will mean continuing caution in our industry.

This caution is also reasonable based on the historical oil price, Figure 3; we see that the $10-$15 barrel is a reasonable historical figure, and the only increase in living memory was the 'oil crisis' back in 1973, Figure 3. This is the clearest indication that the $10-$15 barrel may be a valid lower bound price, and one that will appear again.

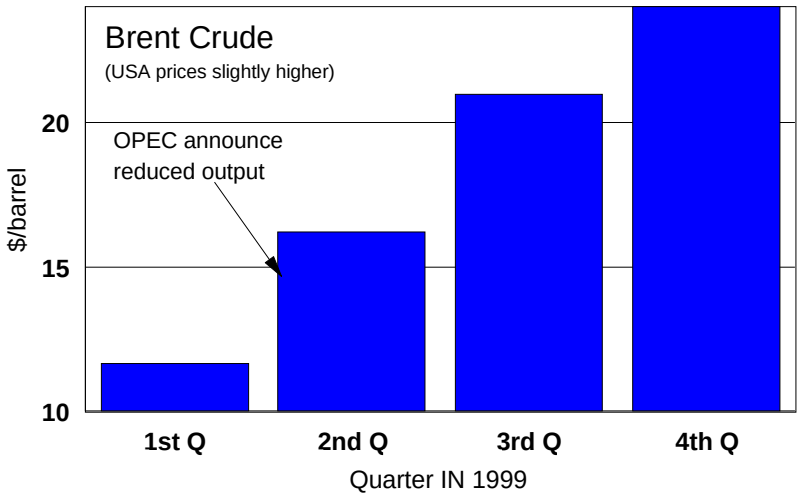


Fig. 2. Oil Price in 1999.

2.4. Oil – just another commodity

The oil and gas service industry has been slow to realise that oil is just another commodity on the world markets. Figure 4 shows the price of oil compared to other commodities. It follows the commodity price trend.

Accordingly, the UK's Financial Times does not see natural resources as an attractive long term investment [7].

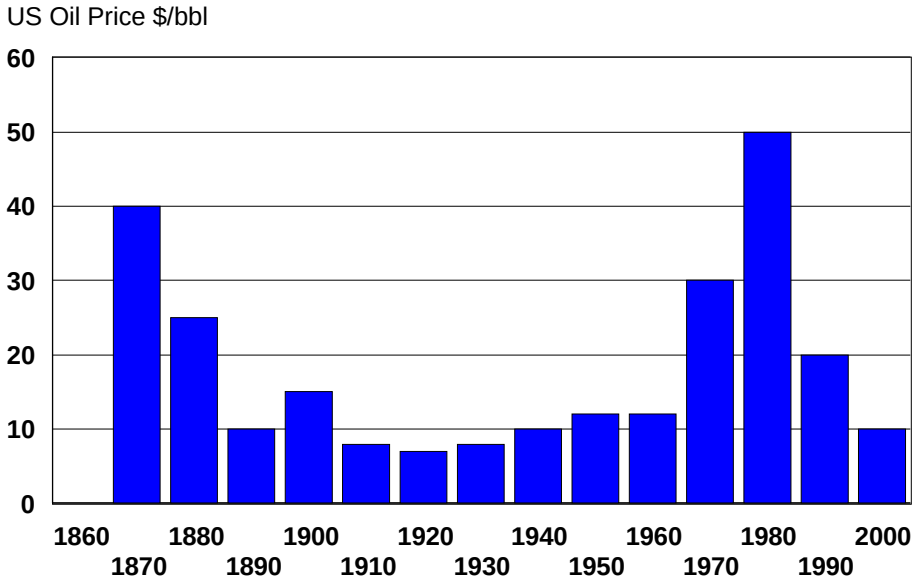


Fig. 3 Historical Price of Oil

The oil business is following other 'commodity' businesses - a decreasing price trend. Individual companies must either become efficient, or combine (see Section 2.1) to gain economies of scale [7]. It is the only way to maintain profitability. The commodity businesses (high volume, low cost) change with time, as illustrated by:

a. agriculture: from small family farms in the 19th century, powered by horse, to huge acreages powered by diesel,
b. fishing: from dropping a line, to nets, to huge factory ships,
c. money: money used to be a gentleman's pursuit, but the need for capital accelerated as the world industrialised. Now money flows every minute of the day, because of electronic business (*e*commerce),

so we should not be surprised with change in the oil business, but note the role of innovation.

The future of the oil industry is considered to be data density and handling - all data and decisions will be handled in a virtual world [8] (See Section 2.7.2). So how can the pipeline service industry survive this commodity engineering/virtual world in the coming years? What will be the effects and changes, who will have the power, and who will be the competition?

2.5 Power

100 year ago the USA dominated the industry, then the Middle East, and soon it will be the former Soviet Union. This poses an interesting problem to the Western World/NATO; the majority of resources are now located in areas not aligned to the western world (9).

With the absence of a single dominant power in the energy industry, the power is no longer the USA or the 'G7', but the national oil companies (9).

2.6 Socio-economic

The next 50 years will see the poor areas of the world gain wealth due to energy, leading to social displacement when the reserves are gone, leading to poverty again (10). Hence, the challenges facing the energy policy makers are greater use of renewable energy, efficiency in conversion and production of energy. Additionally, there needs to be better management of reserves, more social responsibility and more education in developing countries (10). These socio-economic challenges and ethical issues need to be addressed by the powers in the energy industry. Are the majors addressing these challenges and issues?

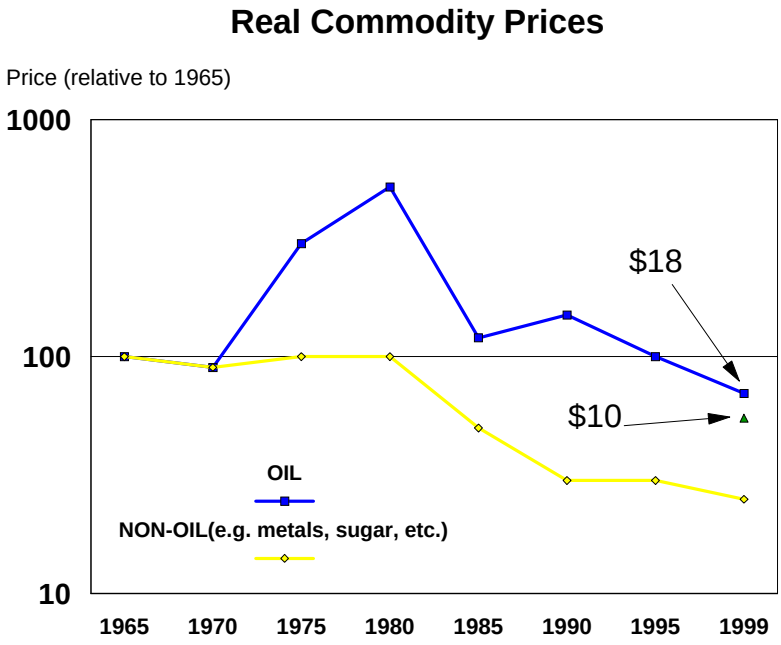


Fig. 4. Oil is just another commodity.

2.7 The change in the stock market and forces against the energy industry

2.7.1 The change in investment from 'value' companies to 'TMT' companies

The market valuation of 'traditional' 'value' companies such as oil and gas, pharmaceuticals, leisure and insurance has been dropping in recent months

(11). This is because the stock market is switching its allegiance to the so-called growth sector dubbed 'TMT' (technology, media and telecommunications). There are over 20 sectors in the UK stock market, but it is the TMT sectors that are booming, Figure 5. For example, the value of Reuters, the information group, has tripled in the past few months, and BSkyB, the satellite-television broadcaster has also tripled to £32billion despite making losses. Contrast this with the profit making oil, gas and water sector (see Table 1 later), who have shown major decreases in stock value, Figure 5.

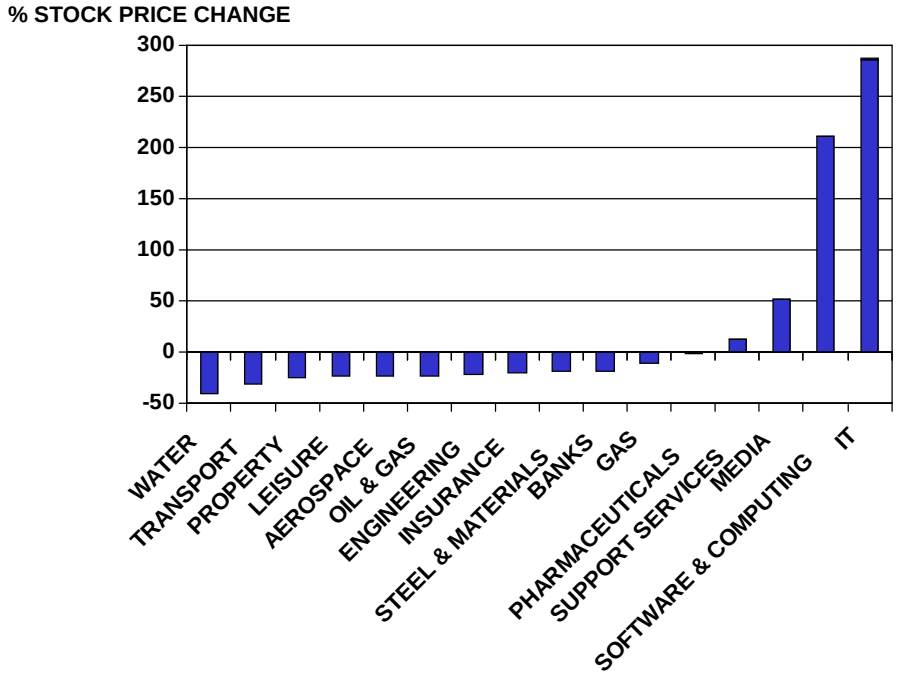


Fig. 5. Change in Stock Price of Selected Market Sectors in the UK FTSE 100 (11)

Our traditional companies may now be undervalued, and the stock market is now reacting, and is starting to move back to them (11); however, recent events (Figure 5) have shown that the oil and gas majors are in for uncertain times, as they compete against the TMT growth sectors. One solution is to convince the market that they are investing in the future via technology.

2.7.2 New competition is around the corner….

As stated above, our energy companies are already competing for capital with these 'dot-com and e-everything' internet companies that are the new darlings of Wall Street. They may soon be vying for customers against new competitors with little or no previous experience in the energy industry (12).

Richard H. Brown, chairman and CEO of EDS Corp has warned *'The energy industry is behind the e-business learning curve, which makes you a target'***. The internet provides more value creation at greater speed than ever before, says Pat Herbert, chairman and CEO of Geonet Energy Services (12).**

That means the energy industry players of tomorrow may look more like the giant retailers of other industries today, such as WalMart and CocaCola. Computerized access to customers is the 'new prize' for the energy industry (12). Joseph Stanislaw, Cambridge Energy Research Associates' president. says *'It is access to the customer that will increasingly dominate across all industries. For energy companies, this shift in focus from commodity to customer will require them to create new service and technology-oriented organizations'***.**

Paul D. Skinner, a managing director of Royal Dutch/Shell (12) says that in the future more refining capacity will be owned by 'merchant refiners' with state oil companies looking to secure markets. Marketers must offer more than commodities... they must provide differentiated products and services to both retail and commercial customers.

2.7.3 Products versus Services

Centrica, UK has recently bought a car breakdown/recovery/insurance service; they appear to be moving from the gas (product) market, to the services sector. Why?

Many ambitious companies are moving from products to services. Unilever, Europe's largest manufacturer of soap and detergents is moving into the domestic cleaning market (then gardening and home repairs). This is because markets for mature manufactured goods such as Unilever's, in developing countries, are not growing fast enough to compensate for stagnated performance in the developed world; products are not been sold, and growth is restricted (13).

Hence, companies are going into the two most attractive markets today; hi-tech or services. Spending on services such as health, education, entertainment and travel in the developed world is now double that compared to products. Unilever estimate the cleaning market in the UK to be $1.3 billion (six times the sales of its top selling product), with profit margins double (20%) that of products.

Another advantage of going into the service market is that quality differences matter. Customers no longer believe there is much difference in products, but the service sector is seen as quality driven; it is impossible to standardise, say, hairdressing, and customers believe that high price in the service sector means high quality and value. The car industry is another good example; profit margins on new cars are poor, but on servicing, insuring, or renting cars, it is much better (13).

2.8 Energy in the 21st Century

2.8.1 Energy market and economics

a. 2000 – 2020.

The US Energy Information Administration (EIA) predicts (14) world energy use will continue growing rapidly until at least the year 2020, particularly in developing nations. EIA's latest international energy outlook

estimates that overall energy consumption will rise 60% during 1997-2020. Faster-than-average growth is expected for developing nations (121%), world natural gas use (104%), and world net electricity consumption (76%).

EIA expects natural gas to be the fastest-growing component of primary world energy consumption, more than doubling during 1997-2020. Gas will account for the largest incremental increase in electricity generation (41% of the additional energy used for generation). Oil is expected to remain the major energy source. In industrialized countries, most of the growth will be in the transportation sector.

The agency predicts US oil production will fall from the current 6.5 million b/d to 5.1 million b/d in 2020, when oil imports will account for 64% of US oil supplies, up from the current 53%.

b. 2000 – 2050.

By 2050 the world population will double relative to 1990, and GDP per capita will have doubled, with economic output quadrupling. Countries seeing the largest increases in energy demand will be (10) China (x 6) and Africa & Middle East and South East Asia (x 5). But energy requirements will only increase by 2.5 due to energy efficiency and less energy intensive activities.

2.8.2 Energy types

Fossil fuel will continue to dominate between 1990-2050 with the predicted increases (10) in coal use being x4.1 and electricity being x3.7. Gas use will 'soar' in the 2000s, outlasting oil by about 20 years (11). However, depletion of fossil fuel resources, the green house effect, uncertainty in energy price and political problems of having a concentration of reserves in a few areas will increase pressure in this area of energy.

Nuclear expansion will be restricted by cost, environment and security. Hydro electric will be restricted by habitat and eco-system considerations.

Shell see the biggest challenge in the future as 'achieving sustainable progress in the face of climatic change', and predicts economic growth via fossil fuels, but decreases in carbon content as we change from coal - oil - gas - renewable energy. Fossils will be depleted and renewables strong because of new technologies. By 2050 renewables will be 50% of world energy (10).

Finally, a word of warning. Increases in oil prices as experienced this year may cause significant change. The Western World will not be able to pay such high prices for long, and this will lead to alternative energy sources being rapidly researched and the above timetables being shortened. A consequence would be that the oil-rich nations of today, will have an abundant product that nobody wants.

3. THE PIPELINE INDUSTRY AND THE NEW TECHNOLOGIES NEEDED

3.1 Historical

Pipelines have been with us for 3000 years. The Chinese used bamboo tubes to carry natural gas circa 1000 BC, and over 1000 years ago, the menfolk of Iraq were encouraged to design and build wooden pipes to transport river water to their villages, when their wives finally rebelled against carrying the water in pots on their heads.

The steel pipeline industry started in Pennsylvania, USA, in 1879 when the construction of a 6" crude oil pipeline started the replacement of horse drawn, water borne, and rail transportation of oil [15]. Long distance pipelines were pioneered in the USA in the 1940s due to war demands, and therefore we can consider our contemporary pipeline industry over 50 years old.

It is interesting to note that the design and construction of pipelines have remained essentially the same, although some design variations are needed to accommodate changes in terrain, climate, product, etc..

The pipeline industry is a conservative industry, and innovation in pipeline technology should be seen as 'part and parcel of the information revolution' (16).

3.2 Pipeline Market

3.2.1 Size

Over 30,000 km of new transmission pipelines are now built every year, the majority carrying natural gas, and over 80% are landlines. The existing infrastructure is huge; the oil and gas pipeline system in the USA alone is approximately 1 million km.

3.2.2 Supply and Demand

Oil and gas provides over 50% of the world's primary fuels. Proven and recoverable supplies (assuming 1999 consumption) are over 60 years for gas and over 40 years for oil.

The demand for oil and gas is huge, and increasing. There are over 1 million tonnes of oil consumed every hour around the world, but just as coal was the fuel for the 1800s, and oil for the 1900s, gas is expected to be the fuel of the 2000s [13].

250 million cu metres of gas are consumed every hour around the world, with 75% of the gas transported by pipelines, and the main importing regions being North America (21% of total market), Europe (58% of market) and Asia Pacific (19% of market).

Gas in Europe and North America is mainly transported by pipelines, whereas gas in Asia Pacific is transported by LNG.

In Western Europe, natural gas consumption has increased by 26% and gas now provides 20% of the European Union's energy needs. By 2010 it may be as high as 25% [17].

Therefore, we have both a thriving new pipeline industry, and a multi-million kilometre international network to service, but before we consider the new technologies we need to service these networks, we must appreciate the position of pipelines in the oil and gas business.

3.3 The need for innovation in the oil and gas 'food chain'

Many years of exploratory work, and engineering have to take place before a pipeline is constructed, Figure 6. We can see from Figure 6 that pipelines form one, small part of a profit chain, and the major savings for the oil majors will be gained from innovations in the geoscience and petroleum engineering areas.

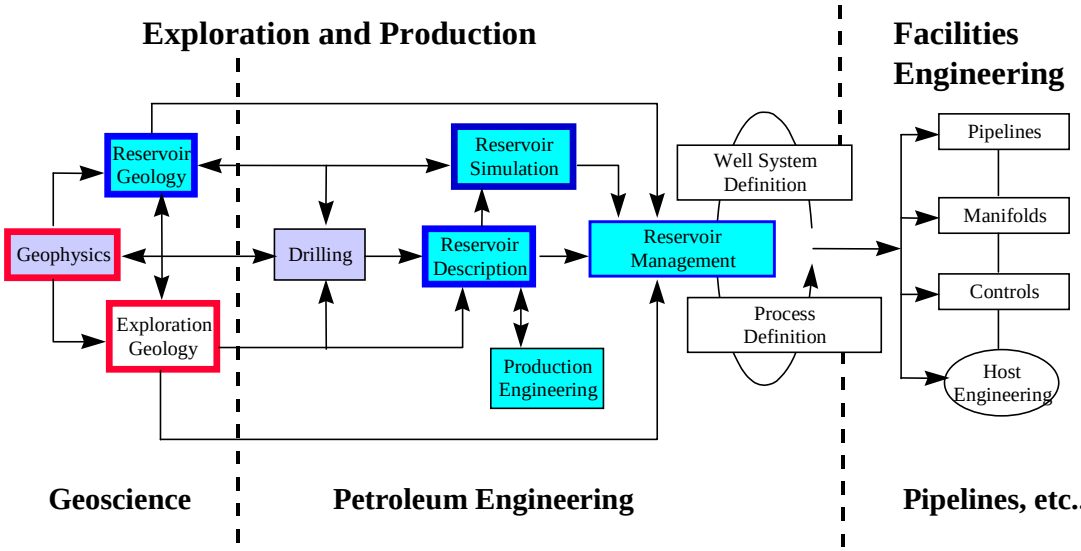


Fig. 6. The oil and gas 'food chain', and position of pipelines.

A volatile oil price (see above) means we need research and development focused at cost reduction, and the (non-pipeline) areas that need addressing are [1,5, 18]:

i. **Seismic surveys, improved geological & geophysical techniques.**
ii. **Drilling (this accounts for 15-50% of total costs).**
iii. **Unmanned or Low cost platforms.**
iv. **Multi-phase pumping and subsea processing.**
v. **'Catalogue engineering' - wholesale standardisation.**
vi. **Integrated 'teams' (within companies), shared databases, and operators / contractors / suppliers working in partnership.**
vii. **Deepwater (>500m) technology - deepwater is where the multi-billion barrel reserves are.**

The savings can be significant. A study for the European Union (19) confirms the highest savings are at the beginning of the 'food chain' and gives the following indication of how reserves have been increased by technologies:

Drilling – 38%
Seismic – 23%
Floating and Subsea – 14%
Cost Reduction Initiative ('CRINE') – 7%
Other Technologies – 18%

The UK Offshore Operators Association's annual report of 1999 estimated that the UK North Sea is about half way through its life, with a decline starting in about two years. The UK Government's Oil and Gas Force predict a fall in production from 5 million barrels of oil equivalent (boe)/day to 2 million boe/day in 2010, although they point out that most predictions prove pessimistic (18).

The way to slow this decline is innovation; the UK's high development costs, and small fields mean the use of existing infrastructures, and extending structural life are key, particularly as decommissioning carries high costs.

Is the North Sea 'finished'? Well, the answer is a 'yes' and a 'no' (20). The big prizes have already gone, but there are many small prizes to be won, and this is why production levels have never been higher in the North Sea, and 344 commercial finds have been made that could go into production in the next 20 years, with 37 new fields currently under development, and 49 new fields currently planned for development (20).

3.4 The need for innovation in new and existing pipelines

The pipeline technology conferences in Brugge and Calgary this year presented many new technologies, and therefore only a summary of the recognised new technology needs are listed below:

a. Long distance transmission (avoid costs of platforms) & 100km tie backs.
b. Risk management methods.
c. Limit state design (whole life considerations, not solely wall thickness).
d. New materials (high grade pipe) and non-metals.
e. Decision (risk) criteria to aid routeing, uprating and inspection and maintenance.
f. Automation and harmonisation of design/codes, with a focus on 'goal setting' codes.
g. Common data standards and transfer.
h. Strain-based design.
i. Fatigue - understanding high strains, overloads, etc..
j. Fracture of girth welds - high strains, pre-loads.
k. Ultrasonic inspection of girth welds.
l. All-in-one smart pigs that inspect for all anomalies in the pipe and its route.

m. Integrated, risk-based inspection and maintenance methods and strategies.
n. Repair, rehabilitation and decommissioning strategies and technologies.
o. Use of internets and intranets to aid design and construction.
p. Use of space technology to assist pipeline routeing and surveillance.
q. Rapid and accessible training for pipeline engineers.

It should be pointed out that most of our challenges over the next decade will be in keeping our existing (old) systems running safely. Hence, companies should be actively looking at technologies and practices that focus on 'old' pipelines.

All the above technologies are aimed at cost reduction, without reduction in safety or efficiency. We also need change in our contracting strategies, management methods, and treatment of key staff. These are covered below.

3.5 The effect of oil and gas majors 'squeezing' contracts and the effect on innovation

3.5.1 New constructions

A major concern in the pipeline business is the way that operating companies are now 'squeezing' the pipeline constructors and design houses on price and how this has the net effect of stifling their ability to develop innovative, cost effective solutions.

This is a symptom of the 'accepted' contracting/supply-chain, highlighted by Ed Vermeulen of Allseas at a DNV Pipeline Committee meeting in 1999, Figure 7. In the past, operating companies managed a large part of a pipeline design and construction. Now they prefer engineer, procure and construct (EPC) contracts that pass on most of the pipeline design and construction responsibilities onto a single contractor.

In business, all those in the supply chain appreciate the pressures on majors to deliver high profits to its shareholders. However, it means every detailed design must take the technology as given and turn it into reality. Construction must be as cheap and quick as possible. It means the cost savings must be higher up, in the conceptual or front end engineering development (feasibility/concept) stage, Figure 7. The questions are - is this happening, and are the operators aware of this situation?

The effect of reduced market prices for design, and the drive towards EPC contracts, is a commodity design and construction service – devoid of design innovation, and price-driven, Figure 7. This makes the design market both unattractive and impractical financially for high quality consultancies, and they are likely to leave it.

The overall effect is that all service companies will not be able to provide either innovation or specialist support, and the contracting relationship may be tense and difficult as the service providers protect small or zero margins.

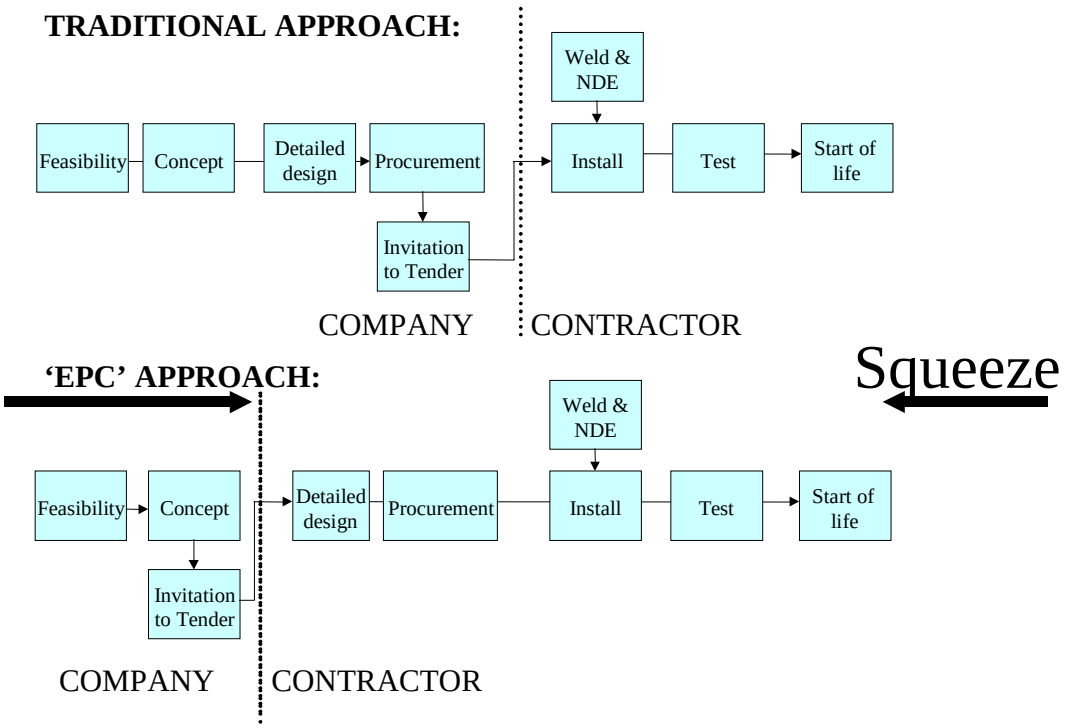


Fig. 7. The EPC contracting approach, and pressure on prices.

The change necessary here is possibly partnering, or long term call-off (service) contracts. This allows the service providers to work closely with the client, to clear service level agreements, and allows these providers some longer term security and cash flow. However, the oil and gas business is tending to award long term service contracts to the large contracting companies, where turnkey services are easily provided. This means that smaller independent suppliers will not be called upon, and will not be able to survive, and when service contracts are up for renewal, the operators may find little choice remaining.

3.5.2 Support contracts

Just as operators are looking for long term 'call-off' contracts in the design and construction parts of a pipeline's life, they are also, particularly for offshore lines, moving to long term service contracts that outsource all the maintenance, and in some cases operation, of their lines to a single contractor. This is a cost-effective way of operating a line, and allows operators to focus on expanding business rather than day-to-day engineering problems.

However, this contracting relationship relies on 'informed buyers' managing the contract on behalf of the operator, and highly proficient and efficient companies caring for the lines. Therefore, the operators need high quality project managers.

These call-off contracts have a significant downside for the service industry:

i. **There can only be 'winners' or 'losers', and as these contracts are often for 5 years, the 'losers' are unlikely to survive until the next contract award.**
ii. **The winners will have difficulty introducing innovation and new technologies as they strive to keep costs down.**
iii. **The losers cannot introduce innovation as they are excluded, and their loss of business will not allow them to spend on innovative technologies.**

3.5.3 Selecting the lowest bid

In business we must compete, and this is increasingly based on price. However, a noticeable change in our industry is in the people who select the 'best' price. In pipeline engineering, this selection should not be left to a contract department. They will simply choose the lowest price, as they know little of the substance of the bid, and a trained monkey can pick the smallest object of three. The selection must be by an 'informed buyer'.

Why? Well, any seasoned project manager will tell you about the folly of basing selection solely on price, and we do not have enough space in this paper to dwell on the huge list of reasons. Therefore, we will leave it to one of our wise forefathers (Ruskin, 1819-1900) to point out the problems with selecting the lowest price:

'It is unwise to pay too much but it is worse to pay too little. When you pay too much you lose a little money... that is all. When you pay too little you sometimes lose everything because the thing you bought was incapable of doing the things it was bought to do.

The common law of business balance prohibits paying a little and getting a lot... it cannot be done. If you deal with the lowest bidder it is well to add something for the risk you run.

And if you do that, you will have enough to pay for something better'.

3.6 Investment by oil companies

3.6.1 Top oil companies and their wealth

The world's top oil companies are now:

Table 1. Top Majors, 1999.

Company	Staff	Market Value (21), £billion (March 2000)	Profit, £billion (1999)
Exxon-Mobil	130,000	175	12
Royal Dutch Shell	102,000	128	9
BP-Amoco (ARCO)	115,000	111	5
Total Fina Elf	154,000	97	2
Chevron-Texaco	71.000	53[3]	5
ENI	81,000	25	3

with all but Shell and ENI being the result of mergers[4].

Oil companies this year have 'bulging bank accounts' [1], following years of restructuring, cost-containment and efficiency drives, but more important, the huge increase in the price of oil in 1999 (see Figure 2), and sustained rises in 2000. Table 1 gives some of the profits made last year. Indeed, the largest USA oil and gas companies have recorded a x5 increase in profits in 1999 compared to 1998. This is an international story; in China, Shanghai Petrochemical Co reported 155% increase in 1999 profits compared to 1998, and Jilin Chemical Industrial Group recorded 125% rise (22).

They can spend their surpluses on [1]:

i. Government taxes
ii. Distribution to shareholders
iii. Reward management
iv. Acquire other companies
v. Build new businesses
vi. Invest in projects
vii. Invest in technology
viii. Invest in research
ix. Invest in people

It is recommended that the oil majors focus on the latter part of the above list, and move the industry forward. They will also need to take on essential socio-economic initiatives (see Section 2.6), and address ethical issues such as dealings with corrupt governments in the developing world. This will satisfy the stock markets requirements for growth (see Section 2.7), and the

[3] Estimated value (2001) after proposed merger has been quoted as a much higher figure. All these numbers are estimates from the press.

[4] Some of these mergers are not yet complete, and estimates of value and staffing are before rationalisations. BP Amoco is valued at £111 billion and ARCO at £17 billion

modern market and employee expectations of proper corporate behaviour (23).

3.6.2 Oil majors' spending

The low oil price in 1998 did not stop oil and gas companies increasing their capital spending by 5% to $83bn in 1998 [24]. Additionally, the slow revival of the oil price in 1999 did not stop majors looking to invest in innovation. For example, BP Amoco plan to spend up to $700 million/year over the next decade to sustain its oil and gas production levels in the UK sector of the North Sea [25]. This investment is to cut exploration and production costs by $2/barrel, which would make business sustainable at an average oil price of $11/barrel. Indeed, investment in 2000 in the North Sea should exceed the investment in 1999, because of the high oil price in the last quarter of 1999 [25].

But there is likely to be problems ahead. Two scenarios have been put forward:

i. **Oil companies have been 'flush' with cash recently, but this money is not being spent on drilling new wells, but on 'defending their balance sheets' (26), and buying back shares. The effect is a decline in building new (high capital investment) rigs, such that if the majors want to rapidly increase drilling, there will not be enough rigs to go around.**
ii. **Increase in oil price is associated with economic recession, and unemployment. As oil prices increase, energy costs more, and industry and commerce suffer. Previous oil price highs (early and late 70s and early 90s), have been followed (about 18 months) with economic recessions.**

3.6.3 Growth not profit

Until recently, most companies wanted to *'maximise shareholder value';* **maximise current revenue and profit. The management consultants had moved in, and they did the simple thing – they look at the allocation of overhead and cost, and concluded that the simple mature products are the best bet for profit, as they require no marketing or development (2). This advice has the effect of:**

a. **allowing downsizing of a company to cut overhead, with little risk on current products, but immediate, positive effect on profit,**
b. **discourages development of new products (high cost, reducing profits),**
c. **creates a risk-averse, non-entrepreneurial culture.**

Short term profit is easy to achieve, and sounds good with the belief that this approach will eventually maximise long term earnings, so you would think that the shareholder would be pleased. Wrong.

Shareholders want growth (see Section 2.7.1), and profit and size are secondary (3) – compare Table 1 with Figure 5. A company's share price is a function of all its long term profits (2). This year's profits will explain only 5% of the share value. The next five years will account for only 20%. The shareholder wants assurance of long term growth. There is considerable

evidence. Boots and Cadbury both went for maximising shareholder value, and their share prices are 40% down on 1999 highs, even though they are making about £1billion profit between them. The early generation of profit maximisers (in the UK, examples are Hanson, GEC, BTR) have seen their share price drop as shareholders perceived a lack of entrepreneurial flair, and obsolete products. Contrast the UK companies Boots, Hanson, etc., with a company such as Amazon.com that has never made a profit, but was valued at more than Boots and Cadbury combined, confirming the modern shareholders preference to growth over both profit and size.

This explains why share prices, and company value increase when strategies are in place that promise growth. Increases in research and development and brand advertising boost prices, and shareholders see little value being created by companies squeezing more cash out of yesterday's products (2). The telecommunication market is a good example, where new companies offering fresh, ambitious products are highly valued (3). The oil majors have lessons to be learnt from today's stock market.

3.7 Problems with pipeline design and construction

3.7.1 Engineering

There is a clear trend to 'dumb down' the engineering aspects of the pipeline business. Just as oil is seen as a commodity, so the associated engineering is seen as commodity engineering; simple, widely available and driven by price.

In simple constructions this is the case. However, in many other cases it is not:

a. As operators strive to cut the cost of developing a new field, there is a growing need for innovation and highly specialised engineering, for example deep water pipeline designs.
b. In parallel, design codes (such as DNV 2000) become more sophisticated and demanding, and the movement towards risk management and goal-setting standards in the USA and UK require designers and constructors to use advance design methods such as limit state design and risk analysis.
c. Add to this the ever increasing demand for safer (to people and the environment) structures, and we are caught in a classic engineer's trap – the customer wants a better, safer, cheaper product in quicker time every year, but wants to pay less every year.

3.7.2 Whole life considerations

Installation/fabrication contractors are selling equipment that will survive the warranty period; essentially at minimum cost to themselves. Oil companies/operators are buying an asset with a life span of considerably more than the warranty period. The regulator and code writer's task to formulate mandatory design codes to cover the two perspectives (operator's

and contractor's) is very difficult, especially given today's contracting strategies, Figure 7.

3.7.3 Quality

Quality accreditation is essential for our designers and constructors. However, it is a surprising fact, that big companies knowingly use unqualified, illegal, unmanaged, and zero-quality controlled companies and people. This is a consequence of the contracting strategies being adopted, where large companies squeeze turnkey contractors (Figure 7), ensuring that these lead contractors must employ the cheapest sub-contractors to do the work, and ensure a profit. It is impossible for some of these sub-contractors to work at the rates they quote without sacrificing quality, training, etc.. Any oil and gas major who believes that some of their service companies are delivering at the current low prices, without reductions in quality and safety, are fooling themselves.

We can put forward a simple example. Currently, in the UK a good quality, young (30 year old) engineer will expect to earn circa $50,000/annum. Consultancies must add onto this salary 'fringe', which accommodates pension contributions, government insurance payments, training, etc.. This fringe needs to be about 25% of the salary, yielding $62,500/annum. If we assume the engineer is 80% 'utilised', i.e. he/she is working on reimbursable work, 4 out of 5 days, allowing time for training, putting together bids, team meetings, etc., the engineer will cost the consultancy approximately $40/hour worked. A consultancy will need to pay 'direct' costs such as office costs, training, administration costs, management, quality assurance, etc.. In the UK this is typically $30/hour worked.

Therefore, a reasonable rate for a good UK pipeline engineer is $70/hour. In 1999, clients were asking for rates of $50/hour, claiming that contracting staff were available for much less. The only way consultancies can provide staff at this rate is by using very inexperienced staff, or reducing direct costs, which would reduce quality and lead to their best staff leaving.

3.8 Change needed in current research and development

3.8.1 Change needed in finance

Current and future research and development, in a commodity market must be financed by those who can afford it, and benefit from it. First, who can afford it?

Table 1 shows the 'giants' in our industry, and Section 3.6 noted the high profits being made by these companies with the high oil price. In Europe, figures for 1998 show most of the majors showing large increases in stock price during the year (the noticeable exceptions being Shell and Gazprom), and this continued in 1999. In 1998 the top major in Europe (based on share price increase) was BG (UK), with the top non-major being Centrica (UK). In the same period the service sector suffered. With the exception of AMEC, European service companies had a disastrous year, with companies

such as Kvaerner, Coflexip and Stolt Comex recording share price falls of over 50%.

The design houses cannot finance research anymore; the squeeze on prices and reduced market, mean there is no money left for research, or training, and the industry has turned pipeline design into a commodity.

The companies who benefit the most from reduced pipeline costs are the majors and their shareholders.

Therefore, in this pipeline commodity market, it is the majors who must take the lead in financing research, and developing new technologies.

This is not the case. Figure 8 (19) shows the overall decreasing trend of spend on technology in research and development, with the oil companies contributing the decrease, while the service and contractor section is providing an increase.

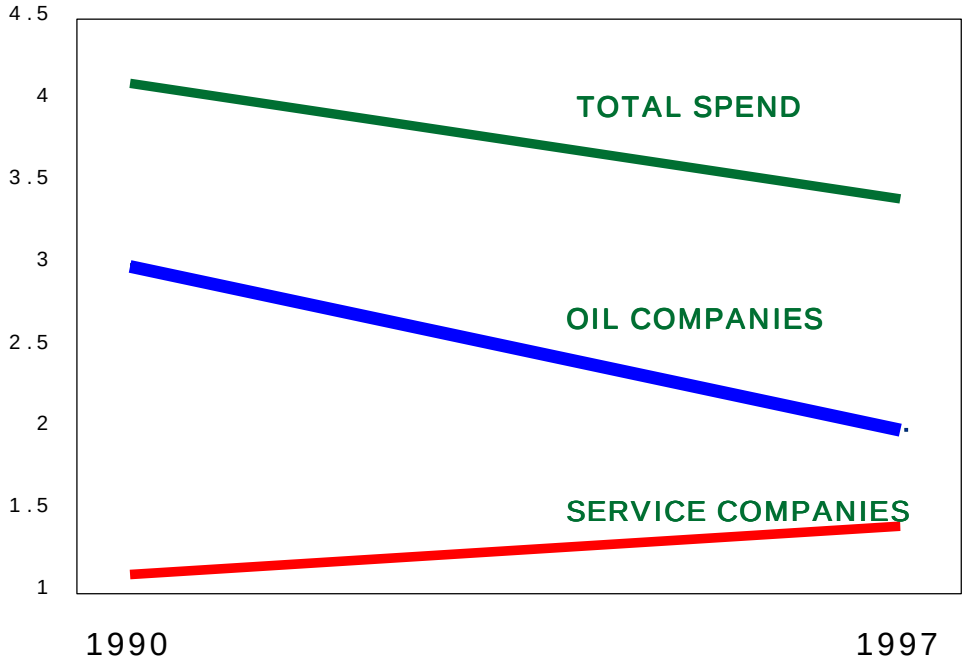


Fig. 8. Decreasing Spend Index on Research and Technology in the Worldwide Oil and Gas Sector between 1990 and 1997 (19).

This decreasing trends by our oil and gas majors may by symptomatic of companies who have lost sight of the importance of technology, and unable to change. The service and contracting companies recognise the importance of technology to maintain market share and lead. Figure 8 indicates the problems our oil and gas majors have with 'change', and shows them to be outdated.

3.8.2 Change needed in research organisations and programmes

Past low oil price, or a future low price of oil should be a benefit to research and development (R&D). History shows that it is a state of war, not peace, that forces major technical developments [5, 27].

Unfortunately, R&D is burdened by a high cost of bureaucracy/administration[5] [27]. This needs to change to:

i. make it competitive and attractive, and

ii. allow cash for inward funding and sale of results.

This will require massive change in the way research organisations run their business, and the major changes will be in their business leadership and project management (see below). The challenge for these organisations is to balance this wholesale change with the long term secure environment needed by researchers to thrive. Without external inputs and co-ordination, and long term financing from the majors or governments, they face a difficult time.

Therefore, the industry needs to support and influence R&D. R&D organisations must put forward well thought out research programmes, conducted by efficient and informed researchers, and delivered to time, cost and quality. Pipeline engineering skills are now scattered around the world, and the 'one stop shop' research organisation no longer exists. Therefore, R&D organisations will need to partner or contract out work, to ensure the customer receives the best product.

It is the operators who must find most of the funding, as they have the largest coffers (see above, and Table 1), and will obtain most of the benefit.

3.8.3 Change needed in code-writing, regulatory bodies and research leadership

The majority of changes that occur in the pipeline industry are centred on new materials (e.g. high grade steels), increased mechanisation (e.g. semi-mechanised welding) or increased scale (e.g. deep water pipe laying).

A good example of change in our industry is pipe joining. Threaded pipe was replaced by oxy-acetylene welding, then electric arc welding, and now the semi-mechanised welding methods.

However, recent years have seen a slowing down of innovative methods in our industry. The transport of richer gases, the use of very high grade steels, and more mechanised processes such as welding and ultrasonic inspection are just a few of the technologies that have been slow to take a hold in our industry.

Also, we now require a large amount of paperwork and justifications to design and build a pipeline, compared to say 20 years ago. Our 20 year old pipeline is fine, and the new one identical, so clearly we are caught in a bureaucracy.

There are three reasons for this:

[5] See also Section 4.2.

i. The reservations of both the code writers and regulatory bodies. These reservations are understandable; the downsizing of the majors, and low margins in the service sector mean that volunteers for code writing are few and far between, whereas the 'more for less' attitude of government leaders is reducing the technical strengths of our regulatory bodies. This results in caution, and hence greater costs.

ii. The loss of skilled staff in the operators. The majors are shedding pipeline engineers, and the project management is now cautious and pragmatic.

iii. Lack of leadership in the industry. We are a very safe industry, but we are increasingly becoming cautious as we lose some of our more experienced staff during these downsizings and periods of change. We need recognised, qualified leaders in all areas of our industry who can set the standards and introduce innovations in an informed, authoritative manner. 20 years ago, technical change in our industry could be instigated on the say of a recognised expert, but now it is often restricted by cautious committees or companies.

4. CHANGE IN THE PIPELINE BUSINESS AND ITS MANAGEMENT

4.1 A Changing World....

The world is changing. We are now in a world that will continue to produce radical changes. For example, we know that the increasing use of computers will eliminate the need to write and draw, rendering the human being unable to handle anything more demanding than a sentence, and we will soon see the end of money. Most money at present exists as binary code, and there is little in the form of paper or metal [28], and we know that the third generation mobile phone, will have capability to process data such as television pictures, and it will make houses with fixed, wired telephone links look positively ancient. Indeed, our precious PCs will soon be exposed as big, cumbersome dinosaurs.

The latest internet technology will be married to our cell phones to allow all our information (business and social) to be relayed via the cell phone. Using 'WAP' (wireless application protocol) or GPRS (general packet radio system) and UMTS (universal mobile telephone system), our cell phones will receive business information, videos, etc., faster than the quickest current ISDN line (29). Your PC will, at best, be a silent 'server' in your home/office, being commanded by you via your cell phone.

4.2 Change in Organisations (30)

The important issue of organizational change has always been a central topic of interest to theorists of industrial relations and organizational behaviour. Early studies focused on a presumed resistance to change among employees. It soon became apparent, however, that much of the resistance could be overcome or avoided by involving those affected in the design and implementation of the change. But it was also discovered that the

management of change is an ongoing and complex political process that requires considerable leadership and resources.

In the 1940s Kurt Lewin argued that successful organizational changes move through three stages, or cycles.

The first stage involves the unfreezing of existing practices or behaviour patterns. This is most easily achieved if the organization is subject to some serious external threat or economic crisis. In the absence of a perceived crisis, employees are likely to see insufficient reason to change.

If practices or behaviours are successfully unfrozen, there is a period of experimentation, or trial and error, with new practices.

The final stage comes as a new set of practices is institutionalized and becomes the standard or accepted way of doing things.

Research has shown that each stage of change can take on the characteristics of an intense political process, in which those advocating the change must attract sufficient support from top management, union leaders, and rank-and-file workers. The job of a contemporary manager or union leader, therefore, has been described as a change agent. As the pace of technological and social change intensifies, the ability to manage organizational change and innovation successfully grows in importance.

4.3 Change in the Pipeline Industry

The pipeline industry is and will experience the changes that all other industries are experiencing. For example:

a. **Organisational change (see previous section)- approximately 84% of US companies underwent at least one major business transformation in recent years. Top three changes were: information technology, business process re-engineering, and business strategy development.**
b. **Automation - in engineering we must accept that most things must become automated, and this includes everything from design to operation. Any task that can be computerised will become obsolete, whereas tasks that require thought and innovation will increase. It is worth reminding ourselves of a famous quote [31]:***'The factory of the future will have only two employees: a man and a dog. The man will be there to feed the dog, and the dog will be there to keep the man from touching the equipment'.*
c. **Technological advances - When you throw away a little birthday card that plays 'Happy Birthday' when it is opened, you are throwing away more computer power than existed in the entire world before 1950 [32]. Indeed, the average consumers wear more computing power on their wrists than existed in the entire world before 1961 [33], and those of us lucky enough to own a BMW car have more computing power on board than was used to put a man on the moon.**
d. **Customer expectations - 15 years ago, customers were attracted by quality. 7 years ago by outstanding customer service. Now, these are taken for granted. It is a 'now' culture; our customers will expect**

automation with rapid or instant availability of both products and services [34].

Clearly, we must change continually to survive in the modern business world.

We have already covered changes needed in contacting strategies, and research and development. We will now discuss several key management and business issues facing our industry. These issues must be understood and addressed if companies are to survive in the industry. I have selected five key areas where change is necessary:

i. Globalisation,
ii. Bureaucracy,
iii. Outsourcing,
iv. Staff,
v. Management.

4.3.1 Globalisation

Globalisation of our industry is introducing intense competition. For example, new pipelines in Africa can be designed in Europe and use pipe from South America.

Some things will never be global; politics is an obvious example, and national boundaries or pride may prevent global commercialism. However, any barrier can be overcome; the football club Manchester United has shown that nationalism can be bypassed. They have fans all over the world, including countries such as China, who log on to their website, buy their replica shirts and watch their matches via satellite link. Their fervour is not doubted, but they would never support the England team if it was to play against the China national team, nor are they likely to buy an England replica shirt. Hence capitalism can cut across national boundaries, but in this case it does not beat nationalism (35).

Introducing innovation into our business is the key to competing on the global stage. As engineers, we are well aware of our scientific laws – Faraday, Boyle, Newton, etc., but in business we should be aware of two other laws: Moore's and Metcalfe's [36]. These laws help us compete globally.

4.3.1.1 Globalisation – Moore's Law

In 1965, the founder of INTEL, Gordon Moore, proposed that the power of computer chips would double every 18 months. This has proved highly accurate for the past 35 years, and experts expect it to be valid for another 50 years. This means a 100 fold increase in computer power every decade, and – more important – it costs virtually nothing to communicate or transact business with anyone, anywhere. We are now truly in a global market.

4.3.1.2 Profiting from globalisation – Metcalfe's Law

The founder of 3Com, Robert Metcalfe, showed that the value of a network is proportionate to the square of the number of users. This means that if only a few people use your network, product, software, game or book, it is

not very appealing. But once a critical mass of users is reached, the value of the network explodes and demand grows exponentially. The growth of the Internet or cell phones are good examples. It is worth remembering that the Internet was around in the late 60s, but it reached a critical mass in 1993, and now is increasing at a rate of 100% every month.

Moore's Law explains what is possible on the global market, whereas Metcalfe's law explains how we can profit from it. Examples of companies who have profited in this way are Microsoft, Amazon, Freeserve, Vodaphone, etc. [36].

4.3.1.3 Globalisation – competition

What does this mean to the pipeline market? First, the cheapness of communications mean we are in a global market, and this means (increased) global competition. Moore's Law predicts that this will become more intense every year. Second, Moore's Law also warns us that competitiveness increases with the use of digital technology and the Internet; this means that traditional assets such as branches and factories may now be liabilities. Third, Metcalfe's Law tells business that to get a quick start in the market, it is actually sensible to give away products free, to obtain your critical mass rapidly. This tactic works (e.g. the Internet browser, Netscape, or more recently, Freeserve), and sacrificing profit for speed can pay [36].

4.3.1.4 Possible application of Moore's and Metcalfe's Law in the pipeline industry

How can we make use of these modern business laws in our industry? One area where we are behind is in the use of information technology. Our designers buy pipeline codes, our constructors have vast files on products, plant and services, and our new pipelines are put into service following huge amounts of paperwork that strictly follow codes and recommended practices.

We can now see a possible change in how we design and build our pipelines, and profit from globalisation. Figure 9 shows an internet-based design service, that links into all other pipeline services. This design service could be offered at very low cost (Metcalfe's Law), to attract customers, and gain the critical mass, and be accessed via software on the Internet. Pipeline design software, such as PLUSONE[6] for designing offshore lines, could be made available to pipeline operators to download and do most of the development and design work, with the assistance of a help line.

Offering very low cost development engineering and design is not high risk to an EPC contractor. These aspects of the total pipeline costs are a tiny fraction. The EPC contractor offering this service would win all these first elements of a pipeline contract, and be in 'pole' position to gain the high value, high margin procurement and construction elements of the contract. Clearly, the low cost services are designed to 'trap' the customer in a web

[6] PLUSONE is a software package marketed by Andrew Palmer and Associates, that aids a designer in most aspects of an offshore pipeline design.

that leads to other elements of the pipeline construction, which in turn would be automated (where possible) and offered at low cost again via the Internet. However, the customer gains from a very low cost, standardised service, is using an organisation that is improving technology, and has the option to choose not to go further into the web.

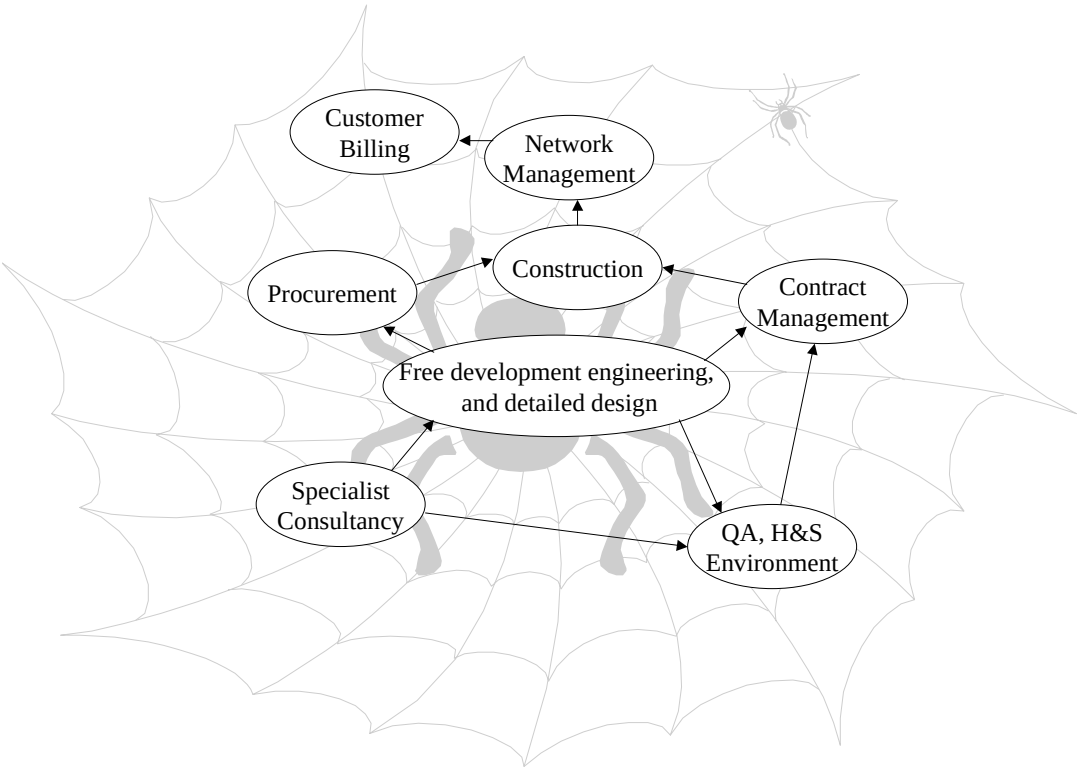


Fig. 9. Possible change in EPC Contracting.

4.3.1.5 Reason why customers would accept change

Customers in any industry now do not want products, they want answers to their problems. Today it is hard to make money out of selling products and services. With globalisation, most industries (e.g. steel making) have excess capacity, and products have become commodities. Price is the name of the game; customers do not believe differences between suppliers amount to much [37].

The most successful suppliers of services (e.g. IBM, McKinsey) are becoming 'solution providers'; they forge partnerships with clients tailored to increase client profitability. They have shifted from selling traditional services and products to providing knowledge of how customers can increase their performance [37].

In this new business environment, the service providers who are seen to provide complete solutions with modern and progressive formats will succeed. Figure 9 is such a format.

4.4 Bureaucracy

The successful companies in today's world offer their shareholders growth. Any company encumbered with a huge fixed infrastructure or a civil service-style bureaucracy will not be able to grow or compete (3).

Corporate bureaucracy is a disease that manifests itself in oil and gas companies' high employment costs [5]. Research shows it is possible to buy in a given skill for 20 - 60% less than the companies' internal rates. Bureaucracy only benefits contracts departments, human resources, etc.. Consider the following example of an invitation to tender (ITT) for a similar, small sized job. The actual scope of work was two pages, but the ITT documents were [5]:

- From a Government Department - 56 pages
- From an Oil Company - 34 pages
- From an Investment House - 2 pages (the scope of work)

Bureaucracy is primarily for control, not efficiency, but the large corporations are becoming more efficient. However, they are still viewed as slow and bureaucratic, and some of the changes suggested below would improve matters.

The service providers in the pipeline business can deliver good, innovative and cost effective solutions to our major corporations, but they in turn must change, and reduce their bureaucracy. This can partly be achieved by increased outsourcing, which in turn reduces companies' costs, and releases more funds for technology development.

4.5 Outsourcing

Most big companies outsource. Services that are peripheral to an organisation's purpose or require specialist knowledge are outsourced, e.g. training and development, IT support services, payroll, product delivery/logistics, facilities management (38].

Outsourcing has many benefits, and few drawbacks. The 'contract' is competitively bid, it is controlled by the company, it is assessed by the company, and it is renewed by the company.

Many big companies are comfortable outsourcing 'low tech' services (catering, security) but departments/staff protect other services that they see as important to their well-being (finance, engineering). These are mindsets that go against the business aims. However, the trend is to outsource everything that you can, and focus on the key business issues.

This change is supported by statistics. Two thirds of US employee's work in the services sector [39]. Every year, more and more people become self-employed. In the UK in 1971 it was 2 million, in 1994 it was 3.4 million.

Large organisations such as the majors will undergo major change in the coming years. It is predicted that less than half the workforce in the industrial world will be holding conventional full time jobs in organisations by the beginning of the 21st century. Those full-timers, or insiders, will be the new minority [40].

The large staffing levels in oil and gas majors are increasingly looking peculiar. For example, 96% of organisations in Britain today have fewer than 20 employees [41].

Obviously, a 'core' of key staff will be needed for any key operation, and there will be problems with continuity and commitment from outsourced staff, but as companies downsize they must outsource to survive. Any department that is downsized, and then claims it can still do the same amount of work, is doomed. A large multinational oil company's staff (going through major change and merger) consider outsourcing 'essential' for 'wider access to skills'.

4.6 Change in employees in the pipeline business

4.6.1 The importance of people

Organisations do not change; people do [42]. Sir John Browne - BP Chief Executive - when asked what his priorities were, on taking over BP, did not answer with 'upstream assets, geographical diversification, etc.', but merely said 'recruiting the right people'. Note the 'recruit', and his vision of him being his own personnel director, and being surrounded by the best possible people. He also stated that 'diversity' (background, gender, etc.) in his people is essential.

4.6.2 Reaction against change

The world of work is undergoing continuous change. Initially, staff are concerned about change, because it creates uncertainty, and this is why 'resistance movements' in companies are quickly and easily created, and must be as quickly killed by management through good communications and information. Additionally, staff who not only resist necessary change, but positively ridicule it must be taken to account; these 'negative experts' mislead fellow staff by acknowledging that change is needed, but highlighting what is wrong with the proposed changes, without offering alternatives. Again, communication and education is needed, but unfortunately this type of staff tend to be stubborn. This is because a 'prophet of doom' is a look risk occupation; if they are right, they will say 'told you so'… if they are wrong, it does not matter because we are all happy that the changes have worked.

Section 4.8 also covers this topic.

4.6.3 Shift in power

Employees are now familiar with change, and are ready for further globalisation, mergers, acquisitions, alliances, etc., into the 21st century[7].

[7] This does not mean that staff do not become 'casualties' of change; a study by University College, UK and the Finish Institute of Health has shown that the staff who survive 'downsizing' suffer from job insecurity, and have to work longer hours (43). The effects are increased stress at work and at home, and increased sick leave. Indeed, the study observed that those remaining after a downsizing, had increased ill health compared to those made

Employees are always at the sharp end of change, and it is employees who absorb the effects, and need to adapt the differing technologies, team working, flatter structures, etc. [44,45].

Keeping your job in these changing times has usually meant working longer hours (46), accepting all change imposed on you, and putting work ahead of all other things in your life.

But things are now changing, and the position of power is also changing. Employees are now so used to change, that they manage their own careers, enhance their prospects of global employment, and reduce dependence on their current employers. Employees are becoming increasingly confident that they are equipped for alternative opportunities, and set their own personal career values and goals. Therefore, whereas employees are still willing to attempt to work the long hours that are needed to manage the increasing workload, they are now saying 'enough is enough', and leaving organisations for alternative employment.

This change in employee dependence creates several important issues that must be addressed by organisations, otherwise they will lose their best staff [44,45]:

i. **Technology is failing to deliver one of its great promises – reduced workloads. *E*mail has created less face-to-face meetings, but more communications to respond or react to. I returned from a one week holiday recently, to find 246 *e*mails in my inbox. One third was junk, one third of little interest, and of the remaining third, only five messages required attention or contained information that I needed. Management control of *e*mail is becoming a major issue in companies.**
ii. **This failure of technology, alongside cost-cutting and other efficiency drives, create further work and stress for employees.**
iii. **Business success is now critically dependent on quick and creative responses to market opportunities. Hence, organisations are encouraging staff to be innovative and forward thinking, but at the same time restricting these staff by ancient hierarchies, and poor reward systems.**
iv. **Organisations are now critically dependent on their top, skilled staff. However, employees are less dependent on their employers. Staff now show less loyalty to their companies in response to less loyalty shown to them.**
v. **The trend towards flatter structures has not ended; it continues unabated. This means that when employees (naturally) turn to their managers for support, they find that their managers are also 'time poor', and cannot deal with the people issues.**
vi. **Organisations need employees to share information to allow business growth. However, employees are either too busy to do this, or are**

redundant. Their job insecurity is seen in the practice of 'presenteeism' – they have to be visible, arrive early, work late, so they can be regarded as useful employees. This results in stress at work and home.

unwilling to share good ideas because it is not in their personal interests to do this.

Organisations will lose key staff unless the above issues are addressed. Retaining key staff is a business issue, and their retention is a priority. Companies may have to increase some levels of staffing to reduce workloads, and look closely at training and developing people to both identify and cope with this changing environment.

4.6.4 Work-life balance

Organisational pressures such as globalisation and downsizing increase staff workload and hours; unfortunately corporate rules judge commitment and performance usually by hours spent at the office, rather than output quality. But now staff balance their careers with their personal life, and look for organisations who can offer a sensible balance. Research has shown that a key criterion for staff seeking an employer is the organisational values; they are looking for a career not centred around work, but one that values personal life (46).

However, we must give a word of caution. Work in our industry can be rewarding, challenging and enjoyable, but workers who want to join your company to 'have fun', or companies who claim to be 'fun' to work for, should be avoided. Staff must now realise why they are at work; to make a profit for the company. Who ever said that business or working was 'fun' (47)? Anybody who thinks or expects that working in any business, including pipeline engineering, will be 'fun' should do two things:

i. get help and
ii. get a life.

Fun is a night with Pamela Anderson, not a multiphase flow analysis[8].

4.6.5 Your money, my time

As a consultant I work with many staff in the large oil and gas organisations; many are very hard working indeed, putting in long hours and saving/making their companies much money. These long hours are not transitional; they are now often institutionalised.

When I work long hours, a client pays, and I am pleased to say that they are still happy to do this – for every hour. This is not the case for company staff; they resist asking for more staff, or external support because this would cost their company money. This make neither business sense (see above), social sense (see above) nor common sense; the next time you work 'till midnight, remember that all the money you save is the company's, but all the time you spend is yours.

[8] Pamela Anderson, for those readers who live a pure life, is a famous 'sex symbol'. To be politically correct, female readers should replace 'Pamela Anderson', with the words 'George Clooney'.

4.6.6 Age profile and the dearth of young talent

Globally we are seeing a shift from 'material resources;' to 'intellectual capital', e.g. computer software, telecommunication. The effect is that young people will not be attracted to the energy business (5). This is a 'death' spiral that has been going on since 1980s.

This is serious, and confirmed by a study by McKinsey which shows that demand for skilled 35-45 year olds will increase by 25% over the next 15 years, with supply dropping by 15%.

We need to nurture young talent, and remember that people are not looking for high salaries (no longer a driver). They look at the 'economics', and will happily be linked to performance measures.

4.6.7 Performance measures

Rewards have traditionally been based on 'time served'. This is now rapidly changing to performance based. Performance related pay (PRP) is controversial, but the Institute of Personnel & Development in the UK says PRP is here for the foreseeable future. 43% of UK (private & public) companies use PRP. Most see it as a means for staff to focus on objectives, and gives a clear message about 'doing a good job'. However, most (74%) agree that individuals' PRP rewards were too low for motivation. PRP has to be big to motivate. How big? A review of CEOs in the USA showed that their basic salary constituted only 12% of their total rewards package [48]. But the 'objective driven' PRP can be good; however, according to the London School of Economics, employers may only get 'what they pay for', with other key objectives ignored if there is no PRP incentive.

4.7 Change in management

Managers need to be in control of all aspects of the business at all times. Information technology has made financial tracking and reporting easy, but other technologies, such as *e*mail, waste time and limit meetings, and modern work concepts such as home working, hot-desking and virtual teams make line management both impersonal and distant. This can lead to loss of control of both staff and projects.

All managers learn very quickly (and often through bitter experience), that if they do not control and monitor their staff and projects continuously and efficiently, disorder soon occurs. Why is this? Two scientific laws help us understand.

4.7.1 Man management control - Boltzman's Law

In Physics we have a 'law' called Boltzman's Law. In very simple terms it tells us that everything goes from order to disorder. This is how the universe was created. It was very ordered, then something happened to change it to disorder. Time is the measure of this disorder. The longer the existence of our world, the more it is disordered. So, we theoretically can go back in time (as Einstein theoretically proved, and NASA demonstrated by

experimentation), but we would have to exert massive external influence, to get back to 'order', and hence go back in time.

This fundamental law applies to management. Control - order. No control - disorder. The longer we leave our management system without control, the more disordered it becomes, and the more external influence will be needed to put things back to order.

The lesson here is that to keep order, you need external influence. This external influence is strong management. Alex Fergusson, manager of the football club Manchester United, says control of staff is key to good management and success.

The conclusion here is that we need good, full-time man managers to create an ordered environment for staff in our modern work environment.

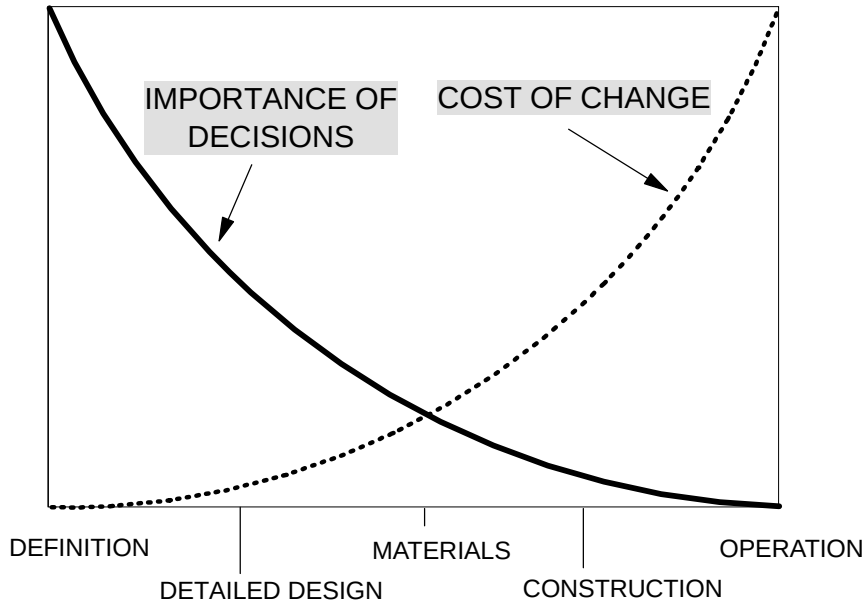


Fig. 10. Cost of Change.

Managers with work overload, and multiple roles will not be able to create this environment.

4.7.2 Project management control – Chaos Theory and the cost of change

Chaos describes the complex and unpredictable behaviour of systems that are sensitive to their initial conditions. Chaotic systems are mathematically deterministic (i.e. they follow precise laws, such as a swinging pendulum) but their irregular behaviour can appear to be random. It is now suspected that economic systems such as the stock market are chaotic.

The unpredictability of a chaotic system arises from their sensitivity to their initial conditions, such as initial velocity. The French mathematician Henri Poincare defined chaos as *'It may happen that small differences in the initial condition produces very great ones in the final phenomena. A small error*

in the former will produce an enormous error in the latter. Predictions become impossible…'. **All project managers appreciate this, and Figure 10 shows the well-known cost-of-change graph, for engineering projects.**

Projects fail due to: i. technical uncertainty, or ii. misjudgement of project urgency. Less than one third of large projects are delivered on time and to cost; the aerospace industry is typically >140% overspent (e.g. Concorde), and the nuclear industry can be 500-1000% overspent [49]. Things are improving through better financial accounting, and good project management is possible; NASA estimated that it would cost $20 billion to land a man on the moon. It ended at $21 billion.

The lesson here is to ensure that all projects are managed correctly by both the client and the contractor. This means an informed buyer, and accredited supplier, who spend a significant part of their time at the very early stages of a project, Figure 10. This is a change in our industry; development and conceptual studies are often seen as low cost, rapid exercises, with many organisations capable of undertaking. This is a misconception, and operators are missing out on real savings in their projects.

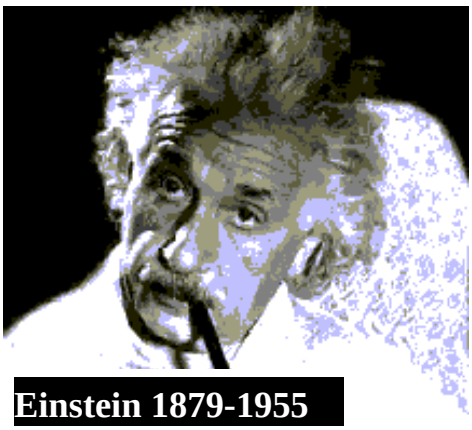
4.8 The need for personal change, 'new' thinking, and resistance against change

We can now see the importance and inevitability of change in our workplace. Two things are now required to help us to be part of change, contribute and understand.

The first thing we need to do is recognise that we must change ourselves, particularly if we are part of a senior team implementing change. The former political leader Nelson Mandela says, '*One of the things I learnt when I was negotiating was that until I changed in myself I could not change others'.* **This can be difficult; many change agents find their biggest obstacles are the same people who initiated the change in the first place (50).**

Second, all parties involved in our changing business must look to change the way they think and any resistance to it. This is important as most companies find that dealing with resistance is the most difficult part of the change process (50).

We can learn from other great thinkers. Figure 11 has Einstein helping us with our thinking, and in Figure 12 Machiavelli explains why 'change' will meet with resistance.



'The significant problems we face, cannot be solved at the same level of thinking we were when we created them'.

Figure 11[9]. The need for 'new' thinking.

'There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system.

For the initiator has the enmity of all who would profit by preservation of the old institutions, and merely luke warm defenders in those who should gain by the new ones.'

Figure 12. The resistance to change.

4.9 Management consultants

It is well known that companies use external management consultants when they need to change, to avoid any political agendas and biases within their own organisation (50). However, it is a major puzzle to many small companies in the pipeline business as to why the majors use management consultants so extensively to change their organsations. In general, management consultants are not regulated, not quality assured, not competency tested, not 'result' tested, have no formal standards, and often are not experienced or qualified in management or business [51,52].

These larger companies would not accept a pipeline consultant with such a flimsy background, and such high rates!

Management consultants will avoid ways of improving or addressing the product (because they know nothing at all about it). Consequently, they avoid solutions that are 'engineering based solutions', because they are

[9] Images in Figures 11 and 12 are taken from Microsoft Encarta Encyclopedia

complicated, cut across the whole company product cycle and are product-based, and require skills and consultants they cannot provide [51,52]. Instead, they can often drift into unquantifiable issues ('feely/touchy things'), such as 'team work', 'communications with lower staff', 'lack of strategic vision', etc., that are ideal talking shops for another consultancy for them!

However, management consultants do not have an easy life; they are often called in to implement unpleasant (e.g. downsizing) strategies, which could be better handled by management. It is primarily *'ass-covering... you end up with consensus management'* **[51,52].**

They may tell you what 95% of your staff already know, but this is useful to a board/management who are new or remote, and it is an independent view.

Nissan UK comment that consultants are *'often used as a crutch by a struggling senior management, who need to be seen to be doing something'***, and** *'sometimes give you solutions that are simply pulled off the shelf and which don't involve much thought'.*

It is well known that consultants charge huge fees, and send in young graduate, inexperienced staff. This is generally not a good thing, unless the staff they are dealing with are also young graduates.

Consultants' abilities in business should always be checked; just as we would insist on an experienced pipeline project engineer, for major projects, we should carefully vet any consultants CV. Have management consultants any proven business or management expertise? Be wary; the recent demise of the new company Boo.com has been attributed to lack of management control (53), *'... although the business was packed with former consultants, few staff had experience of operating sizeable businesses in fast growth areas'.* **Can you imagine a business being run by management consultants?!**

Companies now use consultants in 'tight' mode, and give them a very tight brief. Roy Gardner, Chairman of CENTRICA said [54] *'The worst thing about the company (on appointment was) there were consultants everywhere... nothing ever happened without a team of consultants advising on every decision. I got rid of all of that. We only ever use consultants for specific tasks'***.**

Rolls Royce's Director of Logistics says [51,52] consultants '*still fail to listen to their customers'***, and '***peddle old ideas and try and stuff their views down your throat'.* **Rolls Royce check on consultancy companies management structure and communications with staff, to ensure they employ like-minded companies, but conclude** *'it is difficult to avoid the view that consultants are expensive compared with what we pay our own people'.*

The Scottish National Health Service say consultants have a *'them and us'* **culture, which is not good when staff are worried about job losses. They should work closely with all staff, and share the same** *'bigger picture'.*

The latter quote (*'bigger picture'***) from the Scottish National Health Service is interesting, as you can always tell a company that has been infected by management consultants; the staff start talking corporate gobbledegook using phrases such as** *'low hanging fruit'* **(the easiest targets),** *'helicopter*

view' **(overview),** *'gap analysis'* **(accessing untapped opportunities),** *'think outside the box'* **(have a wider business perspective). Nothing wrong with this shorthand, but does it help the business? The business development director of Barclays stockbrokers says,** *'Workers speak with the blather of management consultants because their bosses pay big money and so they must be right. I heard one refer to a fax machine as an 'online system''* **(55).**

The lesson here is that we must use management consultants with great care, and only employ them for specific, needed tasks, and only use those experienced and qualified in the areas we feel need to be addressed. In fact, we should hire management consultants on the same basis we employ engineering consultants, with a clear scope of work, cost and deliverable, and expect the same quality product.

5. SUMMARY

This paper has presented the author's personal views on the need for change in the energy and pipeline businesses. These changes involve all stakeholders, and are both essential and inevitable.

Some changes and solutions have been proposed; it is now our industry that must decide on the necessary courses of action.

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