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**Abstract:** The last few years have seen unprecedented change in the global market place. Purchasing criteria have changed in line with customer expectation and a new mantra of sustainability echos within the boardrooms of all progressive organizations.

For sustainability to be manifest, three key areas have to be balanced, these are the social, fiscal and environmental aspects of the organization concerned. History has taught us that technology is not the answer. Technology can be bought and sold anywhere in the world and of itself is not the differentiator for any business. Likewise meaningless initiatives typified recently by an Industrial Group suing the EPA on the grounds of who's fault it is for global warming, is as futile as it is money wasting. There is little doubt that the new world economy offers significant opportunity for progressive foundries to earn significant revenue by embracing a sustainable strategy. But to do this, a different viewpoint and consensus must be achieved by the businesses concerned.

The lack of suitably trained and qualified business leaders represents the single greatest challenge moving forward with a sustainable strategy for any organization. Current training and education packages do not adequately address sustainable issues within the technological / business environment. There is a significant gap between the theoretical and applied principles and this gap needs to be closed if new "green businesses" are to be profitable. While we continue to teach traditional cast metals technologies, we will continue to receive "traditional foundry men", who will have little idea how to make money in the new world "green" environment.

This paper discusses the perspective of current global education and research policies from an industrial/practitioner point of view. A gap analysis is offered and a framework for future industrial needs is provided. This paper also discusses the sensitive area of why so many achievers within higher education and research remain disappointingly unemployable within industry and as such indirectly increase the gap further.

**KEYWORDS:** education, training, compliance, supply chain, sustainability, global economic crisis, dip dynamics

The economic crisis of 2008 - 2009 placed unprecedented pressures on all manufacturing businesses to become leaner and smarter in the face of diminishing orders, and customer bases. In many cases most businesses faced little opportunity to sustain, let alone to grow their businesses.

Post the economic crisis businesses that have been able to survive face three, comparatively new yet major challenges, in addition to their ongoing operational business challenges [B], these are:

- Social Responsibility
- Fiscal Responsibility
- Environmental Responsibility

Social responsibility occurs not only within the framework of providing ethical operations, but also the seeming paradox of providing the maximum return to shareholders. Fiscal responsibilities, must also focus on returning an acceptable profit and benefit to shareholders. However, to “grow money, you need money” and currently businesses are facing a significant lack of supply of cash to maintain their liquidity and are facing extinction. Furthermore, and particularly appropriate in the context of the foundry industry, is the challenge of corporate responsibility within the framework of providing a sustainable environment both from a business (i.e. still remaining viable and operational) and an ecological (i.e. respecting and preserving natural resources) point of view.

These three highly constrained challenges demand new thinking in terms of business measurement and new thinking in terms of the reward structure for all the stakeholders. One of the rewards has to be measured as the business surviving or sustaining into the medium and long term and thereby providing a continuing return to the shareholders albeit perhaps of a lesser order of fiscal return than previously expected.

## 1 Sustainable operations within the global village

The realization that business performance and ethics is measured from global perspective is as alarming as it is enlightening. There is not a business in the world that is not affected by globalisation and as such practices in one country are easily reported into a second. The duality of ethics and business principles personified over the last decade or so, for example by moving to low cost countries and/or reducing the duty of care to the employees in an emerging economic region is no longer acceptable in the eyes of the customer and as such places huge pressures on the business to find innovative solutions to remain competitive that are both ethical and sustainable in the eyes of the customer [N,G].

## 2 Differentiation through technology

From the early 1980's industry has seen significant and indeed unprecedented growth in technology from both a “computer generated” stance and from a process improvement stance. However, in line with the move of globalisation, the effect of a global economic crisis and indeed supplier selection and retention policies, it has become apparent, all too late for many, that technology can be bought and sold anywhere, moved and installed in comparatively short periods of time and of itself does not represent a significant competitive advantage or service differentiator.

Indeed investment in more (and similar) capital equipment to drive economies of scale might be the last death nail for many businesses because overheads will increase, but differentiation will proportionally decrease.

### 3 Knowledge capture and retention (the competitive advantage)

If we accept the premise that technology of itself does not provide significant competitive advantage, then where can an alternative and favourable advantage come from? Business processes such as, Lean Systems, linked with the ability to differentiate a product or service in the market place are critical in terms of companies being able to compete and survive in globally competitive market places.

In other-words, it is not the tool, but how it is used by the master craftsman that makes the difference and as such, if a company's sustaining principle is its commitment to, and continued investment in, its people, then that company must accept that it must source, install, commission and continue to maintain its human assets as it would logically do with any other capital asset within the organisation.

To achieve this basic "Lean Principle of People" companies must provide the appropriate improvement procedures and measures (i.e. training and education). However, the world has changed significantly and while trainers and educators continue to teach traditional cast metals technologies, industry will continue to receive "traditional foundry men", who will have little idea how to make money in the new world environment [1].

### 4 The underlying core attribute of business sustainability remains people

For decades, almost in parallel with the growth of technology supported operations, has been the cry from captains of industry that they need more technically competent people in their organisations. Research has shown that "technically competent" has various meanings depending on who within the organisation you are talking to. For example, an operations

manager will be looking for technically competent operators within the shop or production environment, whereas, a strategic business unit manager or director will be looking for highly qualified, technically astute and managerially focussed persons. Often the latter evolve or are recruited from the former, but all too often there is no holistic or clear and appropriate pathway for relevant training and education.

### 5 The Gap

It seems that in line with the growth in globalisation and the continually moving and rapid changes in business, there has been a widening gap between the need for technically qualified people (be they at operations or management level) and the delivery of research focussed activity or theoretical activity more suited to a classroom environment. As such, it is fair to say that two parallel and almost polar creeds have developed, where one seeks to grow and prosper within the applied environment and the second seeks to grow and prosper within the pure or theoretical environment.

The gap appears so wide in certain instances, that a career progression plan begins to appear almost farcical, yet (as quoted below from one interview) remains a vivid insight into the perception and validity of much training and education currently on offer to the very people who are likely to provide the differentiator.

*"To prosper fiscally, you must "do your time" theoretically (i.e. higher education), become assimilated into an organisation (i.e. get a job), focus on the core operational needs of the organisation (forget what you learnt at University or technical college) and at some point in the future undertake reprogramming (i.e. do a higher degree if you want to go up the organisational ladder)."*

When the above quote is considered within the broader aspects of sustainability it becomes apparent that the two polar views regarding training and education needs are actually threatening the sustainability of both industry and indeed the educational base that should in many respects be there to supply industry the people it needs at the level, competence and relevance that industry, (i.e. the customer), needs them [J].

## 6 The increasingly widening gap within the new world economy

The initial stages of dip dynamics are over for most industries in most parts of the world. We have seen the rapid fall of business opportunity, in some cases as high as 80%, we have seen the leveling out of retained business and we have seen tentative reordering and restocking, but certainly not to the level that it once was at pre the economic crisis [A].

Moving forward some sectors are already feeling the effect of the second tsunami and as predicted the availability of cash to grow business, the availability of skilled workforce to support that business and indeed the availability of sustainable customers (i.e. those with the demand and the ability to pay) are still tentative and/or non existent in some cases [E].

The double dip dynamic is also becoming evident for some businesses, particularly those involved in the infrastructure sector, for example, where large government drives to kick start economies have bought forward many capital projects at a point in time where supply of both cash and people is at its lowest, orders have increased sometimes by an order of magnitude, placing further stress on suppliers, their cash flow and indeed their ability to deliver right, on time, every time.

## 7 New supplier partnerships

Whereas every textbook would tell us that strategic partnerships and alliances should be able to overcome some of the problems described above, it becomes logical to assume that the concept of partnership needs to be redefined [H, F].

Furthermore, when many companies seek to outsource their products or services to offset internal risk, for example, the oil and gas industry, then the primary customer ceases to be able to satisfy their own business needs and as such places their own future at risk simply because their suppliers no longer have the critical mass or intense knowledge capital to deliver as they once did [C,D]. This risk may be personified in recent, large scale, product recalls where cost cutting exercises, such as, the retrenchment of technically superior quality and supply chain professionals leaves a time bomb in the operation that is likely to explode just as the point of operational re-growth [L, M].

## 8 Reaching critical mass post the economic crisis

Many business are still operating within a false framework or belief set that suggests a growth in sales is all the business will need to get back to where it was a couple of years ago. Unfortunately, business dynamics is somewhat more complex and managing that growth, in particular acquiring the right critical mass of people, where to get them, how to get them, their level of technical competence, whether they are sufficiently and culturally adapt for moving into the organisation etc., places huge challenges on the business now and well into the future.

## 9 Applied versus pure engineering and a framework for the future

While we continue to have traditional courses, run in a traditional way, monitored by traditional people, then we are going to deliver traditional candidates for non traditional jobs in industry that is now operating in a non traditional market. As such, this will stifle the potential growth of most operations. What is needed is a newer way of thinking where education and professional accreditation can be linked logically and seamlessly and where quality education can be delivered by those with meaningful industrial experience or by those still within the industrial context. Where courses are focussed on problem solving and interaction and perhaps where courses are

delivered more intensively allowing students to gain relevant industrial experience or apply their learning directly into the industry environment whilst within the education environment [K].

Standard academic products such as the MSc and PhD are well suited for those destined to enter into researched based careers, but may not be particularly appropriate for the needs of operational industrialists.

There is a need for a multi-band international educational and training standard for the cast metals industry. Areas of technical speciality must be catered for alongside core general subjects. Importantly, there must be a “cradle to grave” approach to the whole process of learning and personal, professional development. A model framework is illustrated below.

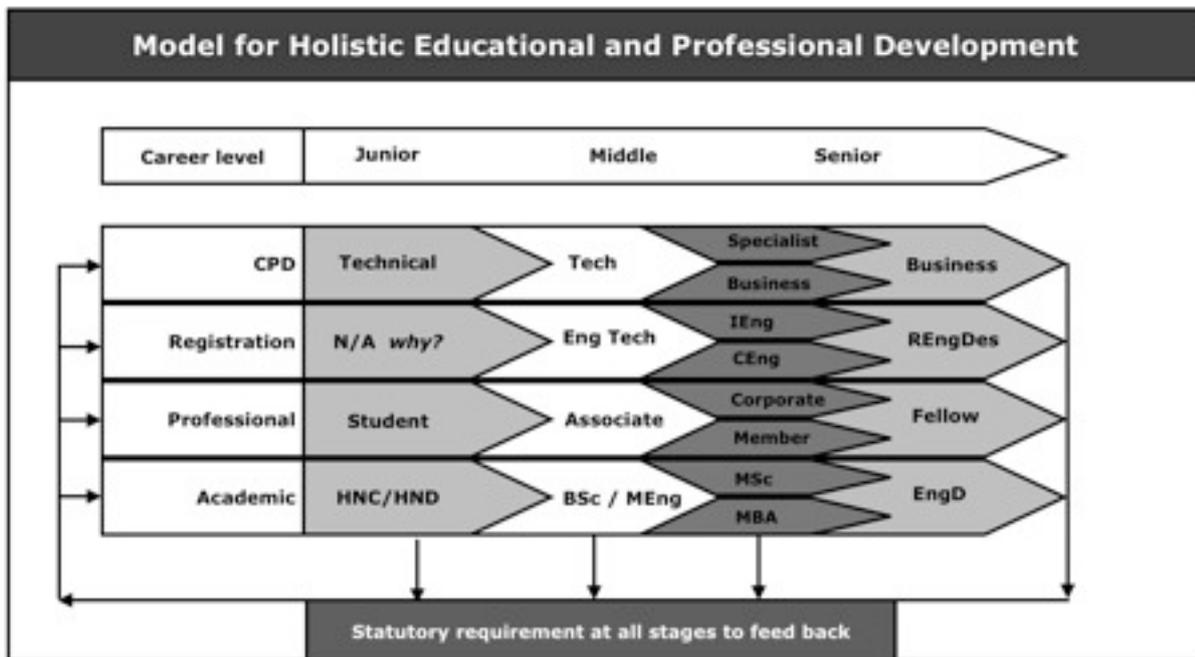


Fig. 1: Model for Holistic Educational and Professional Development

The model will naturally become quite complex because individuals will enter the framework at different points. For example, one would not expect an individual with high achievements in high school to embark upon a

four-year apprentice scheme but rather enter into the relevant degree and then into an industrial post. However, technical competence will still be a paramount requirement within that post.

It may be argued that this model already exists in standard mechanical engineering and materials engineering courses. However, the fact remains that traditional courses do not cover the core aspects of the industry, also a logical progression of learning and development is not always possible. Typically little thought and provision is given to those who progress “up the ranks” (a key element in this sector) and professional recognition does not always have parity with that of the academic world.

Time and flexibility of timing are important issues for the practicing professionals that want to continue to attain further qualifications. As such there is a great need for further part-time, distance and “own speed learning” schemes. Perhaps following an Open University model or similar. However, these types of courses will still need to be accredited and recognised both within academia and indeed industry.

There is a need for accredited courses that have been designed by the sector and/or companies with core elements of in company assignment and industrial relevance.

There appear to be two camps within the engineering educational establishment:

- Pure Engineering
- Applied Engineering

Whereas the academic focus would appear to be fixed on the pure engineering subjects, the needs of industry are such that preference is usually given to people who have a track record of applied subjects.

## 10 Conclusions

Aligning the pure and applied elements is likely to be a generational issue due to the speed and commitment currently. This is likely to result in perhaps the most significant supply gap of the next 20 years or so, (i.e. the supply of appropriate and qualified natural talent).

This in turn, is likely to regress, or destroy, business opportunity and viability which in turn will place significant supply pressures on organisations further along the supply chain. In an extreme fashion this might increase prices and thereby generate global inflation and subsequently drive a global recession. But then a few years ago, a global recession was unthinkable.

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