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IDIOMA INGLÉS

Guías de Trabajo

Departamento de Idiomas
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SCIENCE AND TECHNOLOGY

1.

Mirror, mirror

Telescopes with mirrors made from rapidly spinning liquids could redefine the economics of astronomy

ON the face of it, a telescope with a liquid mirror sounds about as useful as a chocolale teapot. The enormous rigid mirrors that capture and focus light inside large telescopes weigh several tonnes, and take many years of painstaking effort to cast, grind and polish-a process that shapes thcir surfaces to within a few billionths of a metre.So how could a pool of liquid mercury do the same job? The answer is surprising. Pour any liquid into a cylindrical container, rotate the container at a constant speed, and the surface of the liquid will become a paraboloid. which just happens to be the perfect shape for a telescope's mirror.

This idea is not new. Indeed, **it** may go back as far as Isaac Newton. the inventor of the rcflecting telescope. But liquid-mirror telescopes (LMTS) were, for a long time, seen as of theoretical interest only. Over the past decade, however, the idea has looked increasingly atractive, for both economic and technical reasons. A few LMTS were constructed during the 1990S. and the largest yet made, with a mirror six metres across, will soon capture its first light in the forest east of Vancouver, Canada. Advocates of LMTS believe the technology has now come of age-and that it could even spell the end of conventional telescopes.

Causing a stirr

Compared with making a rigid mirror, making a liquid mirror is a picnic. The rnain ingredient is a small amount of mercury, which is placed inside a strong yet light container made of a composite material such as Kevlar. This container is a paraboloid, but its shape does not need to be made as accurately as a rigid mirror. Once the container is spinning at the correct speed (typically a few revolutions per minute), the mercury spreads out to form a layer less than a millimetre thick, and in such a way that variations in the thickness of the mercury layer compensate for the imperfect shape of the container. The result is a liquid mirror as accurately shaped as a conventional rigid one but at about l% of the cost.

There is more to a telescope than its mirror, of course. But when the other components and housing are taken into account, an LMT still comes in at around 5% of the cost of a comparable conventional telescope. The Large Zenith telescope--as the six-metre LMT that is being constructed by Paul Hickson and his team at the University of British Columbia, in Vancouver, is known-is being built on a shoestring, and is expected to cost less than $1 million. In comparison, the construction cost for the two eight--metre Gemini telescopes in Hawaii is $184m, élnd lhe 4.2 metre Southern Astronomical Research telescope being built in Brazil will cost $28m.

The ability to construct Iarge telescopes for a fraction of the usual cost could transform astronomy. It would mean that individual research groups could have their own telescopes. instead of having to book time on shared instruments months in advance, as **they** do now. Having sole use of a dedicated telescope would make new kinds of research possible, too. At the moment it is not feasible to dedicate all the observing time on a six- or eight-metre telescope to search for exploding stars known as supernovae in other galaxies. This is a pity since, in an ideal world, **such searches** would involve repeated observations of the same galaxies every few days. But with an LMT, using a large telescope for such specialised research would become possible.

There is, **however**, a catch: LMTs can only point straight upwards. Tilting the spinning container causes the mirror to lose its shape, so it is not possible to point an LMT at a particular spot in the sky-and even when an object of interest is directly overhead. it is not possible to track it by moving the telescape to compensate for the rotation of the earth.

This restriction is not as limiting as it sounds, though, at least for certain kinds of astronomy. Cosmologists investigating the structure of the universe do not really mind which direction the telescope is pointing, since the universe is isotropic and homogeneous-which is a fancy way of saying that it looks the same in all directions. Similarly, long-term sky surveys and supernova searches can be done with a zenith-pointing telescope: over the course of a year, the telescope can observe an entire band of the sky.

Another drawback of LMTs has been solved by the advent of digital sensors. Use a photographic plate to record an image from a zenith-pointing telescope, and you will end up with a streaky image, as a result of the earth's rotation. Use a digital sensor, however, and it is possible to shuffle the image across the sensor in such a way that it is exactly in step with the earth's rotation.

One of the leading proponents of the Iiquid-mirror approach is Ermanno Borra, a physicist at Laval University in Quebec. **It** was Dr Borra's team that worked out how to coax mercury into forming a film less than a millimetre thick. (Normally, surface tension causes the metal to form much thicker blobs.) Dr Borm also carried out a series of key experiments in the 1990s to show that LMTs would actually work. His research prompted scientists at America's space agency, NASA, to build a three-metre LMT. This is now the 17th-largest telescope in the world and is used to track space debris-another application where the inability to point the telescope does not really

matter that much

Dr Borra is eager to point out that the Large Zenith Telescope, and a proposed four-metre telescope called the International LMT, are being built to do real science, **rather than** merely to investigate the properties of LMTs. He is particularIy excited by the prospect of being able to dedicate a large telescope to the search for supernovae, since these are used as intergalactic yardsticks by astronomers. The puzzuling finding in 1999 that the universe's expansion seems to be accelerating was based on observations of a few dozen supernovae. An LMT ought to be able to find several thousand supernovae over the course of a year, and confirm or disprove this result beyond doubt.

As well as spreading the word about lhe advantages of LMTs, Dr Borra is doing his best to overcome **their** inability to point. A liquid mirror spins once every few seconds, so provided the liquid is sufficiently viscous to stay put for half a revolution when the mirror is tilted, **it** will not lose its shape. Dr Borra worked out just how viscous the liquid would need to be, and found that it had to be the consistency of thick honey. The problem is that mercury is far less viscous than this; and honey does not reflect light, and so would not work as a mirror. The search thus began for a liquid that was both viscous and highly reflective.

As luck would have it, Dr Borra came across a suitable c1ass of materials. They are called metal liquid-like films. Tiny particles of silver are coated with organic molecules so that they float, and are then added to silicon oil. The result is a thin reflective layer that floats on the surface of the oil.

So far, Dr Borra has achieved a reflectivity of 50% (that is, half of the light falling on the mirror is reflected), but he is confident that he will be able to equal the 80% reflectivity of mercury. At this point **it** will be feasible to build a tilting LMT. And he reckons that, if he can build a four-metre or larger LMT that can tilt by at Ieast 30º, that will spell the end of the c1assica1 telescope.

This is a bold c1aim. But suppose it were possible lo build a telescope that could do everything a conventional telescope can do for a fraction of the price -around 10%, by Dr Borra's estimate. The impact of his crazy-sounding spinning mirrors on the economics of astronomy would be nothing less than, well, revolutionary.

Science and Technology

PRE-READING

1. Read the title, subtitles and lines under the subtitles.
2. Look at the picture.
3. Paraphrase “rapidly spinning liquids”.
4. What kind of telescope is the article going to describe?
5. Imagine advantages and disadvantages. Make a list with your partner.
6. Read the first line of each paragraph. Identify paragraphs that describe advantages and paragraphs that describe disadvantages: Identify words introducing them, for example: “restrictions” in paragraph 7th introduces disadvantages. Find similar words for advantages and disadvantages.
7. Now read the text in detail.

READING TASKS

1. Fill in the text comparing and contrasting the two kinds of telescopes described. Remember when you transfer information to a chart you should avoid using sentences. Use short phrases mostly, in Spanish.

	LMT	Conventional telescopes
The process of making the telescopes		
Its general features		

2. What limitation hasn't been solved yet?
3. Go back to the list of advantages and disadvantages you predicted above. Can you add anything to it? Cross out anyone?
4. Find an example of a definition in the text.
6. Can you find instances of the following in this text? Refer to the paragraph:

Description Comparison
Argumentation Narration
Advertising

THINKING ABOUT LANGUAGE

Cohesive devices. Reference and pronouns

A. Look at the highlighted pronouns in the text. What are they referring to? Is there any difference between the use of the pronoun **it** in the second paragraph, in paragraph 9 and 12?

B. Phrases can also work as reference. What do the phrases underlined refer to?

Connectors
A. Explain the function of the following connectors underlined in the text: However - Rather than

PRACTICE

1. Choose the five most important paragraphs in this article. Be ready to justify your choices. Write subtitles for each of them.

2. Choose one of these paragraphs and paraphrase it. You may use the dictionary.

FOUR CAREER RUNGS TO THE TOP

March 16, 1997 C&EN

BOOKS´ *Reviewed by* James D.Burke

1- "There are three kinds of people," someone once observed, "those who make things happen, those who watch things happen, and those who wonder what happened."

2- For those of us who live and work in industry and academia, that cutting remark has a perverse twist. Some people who make things happen- managers, for example- feel overburdened and resent the pressure of their jobs. Many who merely watch would love to be invited to make things happen but are never asked. More than a few who wonder what happened to their dreams do just enough work to get by, while counting the years to retirement.

3- For many years, organizations have regarded technical competence as the surest route to professional advancement. Hence, to prevent the professional obsolescence and resulting incompetence of their staffs, organizations have invested heavily in continuing education programs for their employees. The unspoken premise is that if employees become truly productive and on top of their jobs, careers will take care of themselves.

4- The brightest and most technically competent employees, however, are not always the ones who are promoted. The most productive do not always receive the greatest recognition. Even when those who are passed over for promotion concede that their organizations do try to

Technical competence and productivity alone won't advance professionals through the four stages of career development

"**Novations: Strategies for Career Management"** by Gene W. Dalton and Paul H. Thompson. Scott, Foresman & Co. Glenview, Ill. 1996, 280 pages. $18.95

James D. Burke, a senior member of the corporate staffing department at Rhom & Haas, supervises professional recruiting and career development programs. He has given several campus seminars dealing with industrial research and on planning for professional employment

advance only worthy employees, they can't help becoming confused and discouraged. They worry about becoming stuck. They even may perceive themselves as defenseless victims of favoritism.

5- Clearly, technical excellence is necessary. Nevertheless, it is insufficient for career advancement. Other attributes are required.

6- In the late 1960s, the authors of "Novations", Gene W. Dalton and Paul H. Thompson, then at Harvard business school and now teaching in the school of management at Brigham Young University, began research to identify the criteria used by managers to evaluate job performance. In particular, they asked, "What distinguishes those professional employees who continue to be highly rated in their jobs from those who are not?" They interviewed hundreds of scientists, engineers, accountants and university faculty who were designated by their organizations as high- or low-rated performers.

7-To their surprise, Dalton and Thompson determined that participation in formal continuing-education programs had no bearing on the relative performance rating of employees. They found the factors contributing most to high performance to be the nature and complexity of the job. Moreover, the older the employee, the more important job complexity became as a justification for a high rating.

8- The authors observe, "High performers early in their careers were performing different functions from those of high performers at mid-career. And both of these groups were different from high performers late in their careers.

9- Further investigation led the authors to conclude that the career of a professional can progress through four distinct stages. These stages are determined by an organization's need to have certain functions carried out effectively by trusted individuals. Each stage is different in terms of the tasks to be performed, the personal relationships that individuals must establish, and the psychological adjustments that they must make. The transitions between these stages are likewise different.

10- In "Novations" Dalton and Thompson describe the nature of each career stage and the transition required for advancement to the next stage. They do this in a way that helps the reader focus on organizational needs and on the functions that organizations value highly. This is an important perspective, because career development must take place in and through the workplace. It cannot be pursued as a spare-time, self-help project.

11- To lawyers and accountants, the word novation means "the substitution of a new obligation or contract for an old one by the mutual consent of all parties concerned." In other words, a novation is a renegotiated contract.

12- Dalton and Thompson use this term in an analogous sense. To move effectively from one career stage to the next, employees must "renegotiate" a new set of obligations and expectations with those around them. Even if no formal or explicit agreements have been struck, the employees must understand that life has changed, that activities are different, and that the organization is expected to provide them with appropriate power and authority.

13- The four career stages for a professional employee, the authors state, are "apprentice," "independent contributor," "stage three," and "director". Managers, informal mentors and idea leaders populate stage three.

14- The apprentice stage awaits everyone coming from student life to an organization. Even PhDs cannot escape it. The job-recruiting process creates high expectations for both new employees and their organizations. The organization needs early reassurance that it has hired wisely and seeks confirmation that the new employee will become a valuable contributor. New employees, for their part, need the opportunity to obtain early recognition and the assurance of a rewarding future.

15- The significant factors in the apprentice stage are the initial job, the new employee, and the first manager. Time is also important, but in a different sense. Every new employee needs time to get started. However, the sooner the apprentice stage is traversed, the better. Organizations are reluctant to let this stage continue indefinitely. Employees who fail to inspire confidence within a year or two are sometimes soon dismissed.

16- The initial job lays the foundation for a professional's entire career. Hence, it should be designed to provide both a challenge and a fair test of skills and aptitudes. This job should enable the organization to determine the employee's ability to perform detailed work accurately and without complaint, to exert initiative, to show commitment to the organization's goals, to consider seriously the viewpoints of others, and to communicate well with his or her supervisor. With so much at stake, to give a young professional a boring first job is deplorable.

New employees must display the right attitude and expect to learn. They must be patient with the system: They must acquire the social and interpersonal skills essential to teamwork, if their schooling has not really prepared them for this challenge. New employees are also advised to find a mentor- that is someone who will guide them and show them what works and what does not work. Ordinarily, the mentor is one's immediate supervisor- but not always.

17- The initial manager's duty is to provide clear objectives, responsible direction, and the resources to accomplish the desired goals. The

manager should help new employees to "learn the ropes" and offer them opportunities to grow professionally.

18- When a neophyte has demonstrated competence, it is time for novation to the next stage- that of independent contributor. This is what people ordinarily think of when they refer to someone as a "professional". Indeed, nearly half of all professional employees are found in this category, and they are indispensable to an organization's well being. However, they have rather different responsibilities than those of employees in the first stage, and they must behave differently.

19- Independent contributors, who are people having broad technical responsibilities and who work with relative independence, manage time with great autonomy, and are recognized as experts, must abandon some of the attitudes and behaviour that had served them earlier in the apprentice stage.

20- They must do what it takes to be viewed as technically skilled, self-starting, focused, and confident. They must establish a closer relationship with management, based on earned trust. They must take responsibility for originating key projects. They also must acquire a professional image.

21- Independent contributors encounter their own special set of problems. Having acquired considerable autonomy, perhaps for the first time in their lives, they face pivotal decisions that will shape their professional careers. Are they willing to put in the hard work and long hours required to achieve consistently high performance ratings? Should they work as specialists or as general problem-solvers? Do they want to manage? Should they change employers or occupations?

22- It is at this stage that many professionals come to terms with their personal values and drives and begin to take a long view of their lives.

23- For those advancing to stage three, technical expertise is not enough. They also need a broad understanding of the organization, superior persuasive and motivating skills, and an earnest desire to develop the talents of others. Stage three is not for everyone. Those who are happiest with exclusively technical work and who would rather not have to guide others do not belong there. Neither do people who are unwilling to accept responsibility for the mistakes of the group.

24- Those in stage three – the managers, mentors, and the idea leaders (or whatever those on the technical, rather than the managerial, ladder may be called)- are often very busy people. Sometimes they feel squeezed by the demands of those above them or below them.

25- Unfortunately, Dalton and Thompson do not report on events since 1992 and have failed to anticipate a major current crisis in management. Specifically, the ranks of second level management are being cut drastically. The survivors are working harder than ever to preserve their jobs. They may not care (let alone, be able) to make much time available to groom younger employees in the mentoring function.

26- The mentoring process enables organizations to prepare young employees to replace current management. In recent years, mentoring has become recognized as so valuable that some organizations formally assign mentors to new employees. This is a misguided approach. The relationships are richer and more productive for the organization when this process is left to occur on its own.

27- There is an even worse side to the present crisis. Because of corporate streamlining and mergers, fewer leadership positions now can be aspired to. Unlike the situation 25 years ago, the vast majority of young professionals now joining major companies can never expect to hold a middle-management job. Organizations will be challenged mightily to find alternative incentives that will keep their young, ambitious achievers interested.

28- Because executive competence is so vital to an organization's well being, a description of the director's stage dominates "Novations". From many interviews, group discussions, and a study of organizational strategies for executive development, Dalton and Thompson find four closely linked behavioral patterns that characterize people in this fourth stage: a strong drive to provide direction, to exercise power, to represent the organization publicly, and to encourage and support key individuals.

29- The stereotype of the ruthless, power-grasping egoist does not stand up. Stage-four people tend to collaborate in loose coalitions, rather than function as individualists. Their public and private lives are generally happy and stable. Although they travel often and must delegate authority, executives usually retain some direct supervisory responsibilities, which they thoroughly enjoy. Most spend their careers in only one or two organizations, and quite a few are engineers or scientists. In stage four, managers predominate, but some are project directors or "product champions". Others, sometimes referred to as idea innovators, are found more often in smaller, high-technology firms, where ideas and knowledge are especially prized.

30- Providing direction begins with a creative, realistic vision of what the organization should do next. Effective managers view the competitive environment and their organization's capabilities sagaciously. By sound timing and persuasion, they lead subordinates to embrace responsibility for achieving a piece of the vision.

31- Power is a neglected aspect of management, perhaps because it is so seriously subverted to personal ends. The most emotionally trying aspect of the novation to stage four is learning how to exercise power. To enjoy trust and broad support, leaders must demonstrate that they can use power wisely and responsibly for their organization, while taking the employees' interests into account. Dalton and Thompson rightly view executive power as a sacred trust- and its abuse as shameful.

32- When executives establish effective relationships both inside and outside their organizations, they can gain access to otherwise unobtainable information and support. In so doing, however, they must appreciate the needs of others and be socially responsible. They also must understand the value of reciprocity.

33- The sponsoring of qualified employees for advancement to more responsible positions enables directors to assure their organization's future. Proper timing and good judgment are required. Sometimes tough decisions must be made, and mistakes must be corrected as soon as they are recognized.

34- And so the route to career advancement and satisfaction is mapped in this book with clarity and insight. The route is not exactly straight but, on the other hand, it is not shrouded in mysterious shadow. Always practical, Dalton and Thompson propose that those seeking to move up should study what the novation to the next stage of their career demands and then act accordingly. By their achievements and style, the ambitious must lead their managers to believe that advancing them is desirable and safe.

35- The authors are adept storytellers, despite an occasionally obscure statement. Interlacing concepts and illustrative anecdotes, they have constructed a comprehensive and consistent model of how careers evolve. They offer principles- not gimmicks- for the benefit of both organizations and their employees.

Dalton and Thompson let their findings largely speak for themselves. The closest they come to editorializing is to express regret that so many professionals display no ardor for their life's work, but grumble in their mediocrity.

"Novations" is a valuable contribution, with something for all professionals. To those who make things happen, it offers a practical system; to those who watch, wisdom and hope; and to the rest, enlightenment.

ACTIVITIES:

Burke, J "Four Career Rungs to the Top" *C&En* March 1996 pp28-30

El presente texto será abordado en base a las estrategias cognitivas necesarias para su comprensión. Así dividimos las actividades en tres etapas, a saber: anticipación, verificación y reformulación o internalización.

ANTICIPATE

1. Read the bibliographical data.
2. Which are the proper names mentioned? What / who are they? How are they related?
    i. What information about the author of the article can you find?
3. Read the title and the subtitle. What word in the subtitle is "**rungs**" related to?
    i. What is "Four Career Rungs to the Top" the title of?
4. Notice that the word "**career**" is related to "**productivity**" and **"professionals**"? Is it then a cognate?
5. Read the last line of paragraphs 2, 3, 4 and all paragraph 5 and decide which of them is essential and which can be skipped?
6. What is the writer's purpose? Remember the words "**rungs**", "**stages**" and read paragraph 5 again. Advance a general reading hypothesis.
7. Which word or phrases help you detect the beginning of the body of the article and the conclusion? Which sections contain the most central information? Why?
8. Read the first line of paragraphs 14-17. Which word or phrases signal that these paragraphs belong to the same section? Idem for paragraphs 18-22
9. What is the organization of the text?
10. Scan paragraphs 14-33 for cognate words or phrases. Choose 25 of them. List them and group them into the four stages mentioned.

VERIFY

La etapa de la verificación permite la reconstrucción o rechazo de las hipótesis elaboradas en la anticipación.

1. Read paragraphs 13 to 32. Underline the main sentence in each paragraph. Is it possible to skip any paragraphs?
2. Make a list of the main concepts outlined in paragraphs 13 to 32.

3. What is the purpose of the questions in paragraph 21? What do they signal? How are they related to your hypothesis?

4. Read paragraphs 5 **and** 25 only. Why has the author of the article used the words "Clearly" and "Unfortunately"? How do these paragraphs differ from the rest ?What is the writer's purpose?

5. Explain the meaning of the following connectors and the ideas or concepts that they connect.

a. Nevertheless (paragr 5)	Hence (paragr 3 and 16)
b. However (paragr 15)	However (paragr 18)
c. Although (paragr 29)	Unlike (paragr 27)

6. Read paragraph 20 and try to account for the use of the modal verb MUST in all the sentences.
7. Read paragraph 21 and account for the use of modal verb SHOULD in the questions.

8. Complete the following chart. Indicate the five most important paragraphs. Write the main concept of each and indicate the function of the paragraph in the text structure.

PARAGRAPH	CONCEPT	FUNCTION

INTERNALIZE

La tercera etapa permite elaborar una reformulación de lo leído a partir del texto y de los propios esquemas y conocimientos previos. La elaboración de un esquema ayuda a una reconstrucción del texto, una comprensión más profunda y una organización del recuerdo en el futuro.

1. Make an outline of the article. Hierarchize and connect the concepts. Include details. Cluster the details that belong to the same concept. Try to express concepts in noun phrases. Indicate closure. Use either L_1 or L_2.
2. Write the main idea of the article in one or two well-written sentences in Spanish.

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Lessons learned from tsunami damage in Sri Lanka

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Around 300 000 people were killed by the tsunami that followed the Sumatra–Andaman earthquake on Boxing Day 2004, making it one of the worst disasters in modern history. Up to 40 000 died in Sri Lanka alone, where around 80 000 houses were also destroyed when waves up to 15 m high swept ashore. This paper reports on how coastal buildings and infrastructure in Sri Lanka behaved under various tsunami wave heights and the many lessons learned for reducing vulnerability to future events. In particular, newly published national guidelines for reconstruction emphasise the importance of tying down structures against upward and lateral loads as well as the need to anticipate and reduce soil scour around foundations, especially of backfilled earth.

The Sumatra–Andaman earthquake in the Indian Ocean off the Sumatran coast on Boxing Day (26 December) 2004 measured around 9·3 on the Richter scale and generated a tsunami that affected many countries around the Indian Ocean, including Sri Lanka (Fig. 1). The entire coastline was affected by a combination of direct, diffracted and reflected waves (Figs 2 and 3). Wave heights are estimated to have reached up to 15 m from mean sea level in Ampara on the east coast. However, typical wave heights were lower than this and the maximum height of water experienced by structures lower still. The structural damage described here was caused by wave heights of 2–5 m from structural foundation level.

This paper describes how a variety of coastal structures in Sri Lanka behaved under tsunami loading. The objective is to identify from such performance the factors that make structures more resistant against tsunami attack. Depending on the wave height, various types of structures were affected. In general, both static and dynamic loads are dependent on wave height, since wave velocity is also related to height.[1] Hereafter in this paper the wave heights referred to are from the structure foundation level and not mean sea level.

At relatively low wave heights of up to around 2 m, it was mainly 1–2 m high boundary walls that succumbed. As wave heights increased, single-storey masonry structures were significantly damaged and were completely swept off their foundations at wave heights of around 4 m. Where even higher energy waves of 3–5 m height were accompanied by significant scouring, two-storey structures failed through undermining of foundations. It should be noted that the main threats from a tsunami wave on

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Fig. 1. Sri Lanka was around 1500 km from the epicentre of the earthquake of 26 December 2004 but directly exposed to the ensuing tsunami (M, magnitude on the Richter scale)

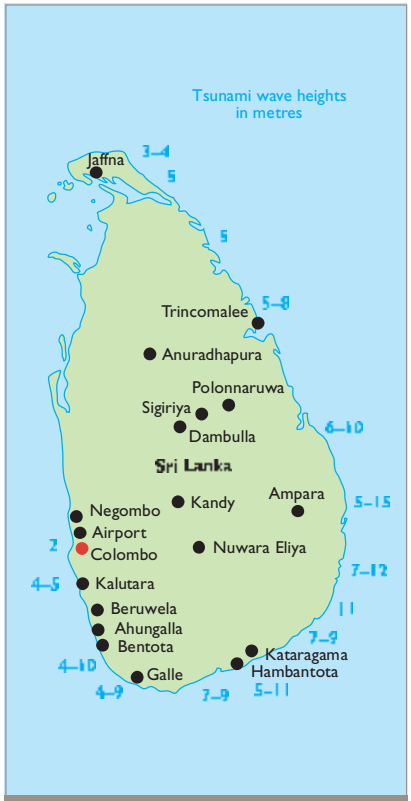

Fig. 2. Estimated tsunami wave heights around Sri Lanka ranged from 15 m above mean sea level on the east side to 2 m on the west side (courtesy Dr S. P. Samarawickrama)

a structure are overturning, sliding and scouring.[2] Debris impact is also a concern, although not focused on here.

This paper deals with the subject matter in a qualitative manner. The quantification of force, resistance and stability entities is currently under way. A preliminary paper compares static and dynamic tsunami loading with structural resistance against sliding and overturning.[3] The qualitative treatment in this paper involves identifying structural forms that have performed either poorly or well, and suggesting guidelines for robust construction. The emphasis in the guidelines is therefore on robustness, as opposed to strength to resist a given force. The proposed structural forms can subsequently be designed for the appropriate forces.[1] Meanwhile, increased structural robustness will always reduce structural failure under extreme events and thus save lives.

Fig. 3. NASA satellite image of tsunami waves inundating Kalutara on the west cost of Sri Lanka on 26 December 2004 at 10:20, about an hour after the first wave hit (Copyright DigitalGlobe)

Fig. 4. Vertically extended, a 2 m high boundary wall only suffered local damage due to its original coping serving as horizontal bracing and vertical bracing being provided every 3 m

Fig. 5. Additional weight of the water tank ensured the structure immediately beneath it remained intact

Boundary walls

Boundary walls in Sri Lanka are often not designed and/or very poorly constructed, since they experience large lateral loads only infrequently. In some cases, walls of up to 2 m in height had been constructed in 100 mm thick masonry with hardly any vertical or lateral bracing. Most of these walls collapsed by overturning during the tsunami. Fig. 4, however, gives an example of part of a 2 m high wall that suffered only local damage because it had been constructed in two stages, with the first stage coping beam serving as an intermediate horizontal bracing for the overall wall. The wall is braced vertically at around 3 m intervals too.

The vertical cantilevers were strong enough to resist the lateral load until failure of the lower panel took place, after which the lateral load was reduced; complete overturning failure was thus avoided. This suggests that horizontal and vertical bracing is desirable for boundary walls of significant height. The columns should be of reinforced concrete (as opposed to masonry), so that anchorage to foundations is possible.

Water tanks

Many detached single-storey houses in Sri Lanka have a water tank (1–2 m^3) located above a chimney. In many cases, it was observed that the part of the house near the water tank was intact, while the rest of the house had collapsed under wave heights of typically 4–5 m (Fig. 5). This is probably because both the weight of the water tank and the box type plan form of the supporting chimney contribute to stability.

On the other hand, where water tanks were independently supported by four columns, masonry columns were found to perform very poorly. The entire tower had collapsed and the water tank had been thrown for a considerable distance. Even where an intermediate horizontal bracing was employed to connect the columns at mid height, collapse had occurred because there was little connectivity between the masonry columns and the reinforced concrete bracing.

Obviously weight improves stability but, if overturning occurs, the heavy water

Fig. 6. Many single-storey structures were completely pushed of their foundations due to sliding failure

Fig. 7. Toilet blocks with cross walls tended to survive intact

tank can become a lethal missile. Hence if only masonry is affordable for supporting small domestic water tanks, box-type towers should be used. Ideally braced concrete columns should be used—and these would attract less load too.

Single-storey structures

Most single-storey structures are constructed in masonry using either cement–sand hollow blocks or brickwork, generally on random rubble masonry foundations. Little or no reinforced concrete is used, which means that there is no tying down of the structure. Many such structures were completely pushed off their foundations in sliding mode at wave heights of around 4 m, especially where walls were only 100 mm thick (Fig. 6).

The resistance against sliding is offered by the bond between the wall bases and foundations, which is often weak because a layer of tar is used as the damp-proof course; and by frictional resistance, which is also low because the weight mobilised to generate the frictional resistance is lowered as a result of submergence—that is, the frictional resistance is equal to the coefficient of friction multiplied by the submerged weight, which is the gravity load reduced by upthrust in water.

The performance of such structures can be improved by providing reinforced concrete columns founded on pad footings at least at the four corners, and continuous reinforced concrete beams at roof and plinth levels, so that some frame action and tying down is introduced. In fact, such tying down of elements from roof to foundation is essential for resisting high wind speeds and cyclones too.

Fig. 8. Though suffering little structural damage, this robust toilet block was completely overturned due to inadequate foundation depth

The use of 200 mm thick masonry at least for external walls will also help by increasing the weight available for mobilising sliding resistance; such thicknesses will also be required for adequate moisture penetration resistance and thermal insulation. These lessons have been incorporated in a recently published set of guidelines for buildings at risk from natural disasters.[4] The cost of incorporating such robustness-improving features is probably not more than 10–15% of the original cost.

Single-storey structures with cross walls bracing the sea-facing wall performed better than those without such walls, especially where wave heights were not high enough to cause complete sliding failure. For example, toilet blocks that had cross walls at close spacing performed very well, even at wave heights of around 4 m (Fig. 7). On the other hand, very robust toilet blocks suffered overturning failure without much disintegration at wave heights of only 2 m (Fig. 8) if their foundations were too shallow.

Wells are also robust structures due to their circular plan form. This same form makes them hydraulically efficient, result-

ing in a lower horizontal wave load. As such, virtually all wells were left standing, even though adjacent houses were destroyed. There was also some evidence that buildings with corners facing the wave direction (as opposed to being square to the coast) performed better—once again both structural and hydraulic factors would contribute to this.

Most religious buildings were also not severely damaged, probably due to better design and construction, compared to domestic structures. In some cases, walls were around 350 mm (one-and-a-half bricks) thick, compared to the half-brick walls of normal houses. The rounded shape and smoothened surfaces of structures such as statues would also have reduced the drag forces on them. The high self-weight of these structures would have precluded sliding failure too; it would however have exacerbated settlement due to scouring (see Fig. 9, where the wave height was 3·5 m).

Shielding of houses by those closer to the beach also contributed to reducing damage. Natural protection was also offered by trees, especially by mangroves, and by sand dunes. The creation of a buffer zone with appropriate vegetation is a land-use planning strategy for reducing tsunami damage.[2] This strategy is being explored in Sri Lanka too.

Fig. 9. Religious buildings generally suffered little structural damage due to their heavy weight, robust construction and hydraulically efficient shape, though the weight exacerbated scour settlements

Fig. 10. Many single-storey structures were completely destroyed while adjacent multi-storey buildings remained intact

Multi-storey structures

Multi-storey structures performed much better than single-storey ones. This is because of the greater weight that resists overturning and sliding failure. Furthermore, a large part of that weight (especially if the structure was over two storeys high) was not submerged and hence made a greater contribution to stability against lateral load. At many locations such as schools and tourist hotels the contrast between single-storey and two-storey structures was stark, with most of the former having been swept away while the latter remained intact (see Fig. 10, where the wave height was 4 m).

The other reason for the survival of multi-storey structures is that they are concrete frame structures. In most such buildings, infill brick walls perpendicular to the advancing wave direction had been punched out, especially if they were of 100 mm thickness. However, infill walls parallel to the advancing wave direction remained intact with virtually no cracking, bracing the frames against the horizontal wave loading (see Fig. 11, where wave height was 3·5 m).

Fig. 11. Multi-storey concrete framed structures generally performed well, though infill brick walls perpendicular to the wave direction were often knocked out

A hotel building with load-bearing walls (as opposed to concrete frames) also performed well at the same wave height of 3·5 m, especially because the load-bearing walls were oriented once again in the direction parallel to the advancing wave; only one of the outermost (end bay) walls had been knocked down, causing a partial collapse of the floor above (Fig. 12). Hence, it would not be advisable to rely on load-bearing masonry in tsunami-prone coastal areas.

It was observed that even very rudimentary structures that had only columns on the ground floor (i.e. without walls) performed well, an example being a beachside restaurant after experiencing a 2 m wave height (Fig. 13). This is because the columns attract only minimal loads. Structures built on stilts, common on the coasts of some countries (though not in Sri Lanka), are based on the same concept.

The more significant problem for multi-storey structures was the scouring of sandy soils at the corners of buildings. This scouring occurs probably as a result of eddy formation as the wave advances and recedes across the building. In some cases complete collapse of some end bays had occurred, especially where both end corners had been undermined. Fig. 14 shows a school building extensively damaged by a wave height of only 3 m. Furthermore, in school buildings constructed to a type plan, the main beams in the transverse direction are supported only by two end columns; hence there is no redundancy in this direction.

In others, the presence of infill walls adjacent to the corner columns would have contributed to stiffening the undermined area and preventing collapse

Fig. 12. Only the end bay of this multi-storey building with load-bearing brick walls collapsed since the walls were parallel to the wave

Fig. 13. Simple timber construction, with a complete absence of walls at ground level, helped this beach restaurant survive largely intact

Fig. 14. The end bay of this concrete-framed school collapsed due to scour of the sandy soils under the foundations and a lack of structural redundancy

Fig. 15. Infill walls adjacent to this seriously undermined corner column helped prevent the building collapsing

Building stiffness should be enhanced by the provision of ground beams and infill walls adjacent to corner columns.

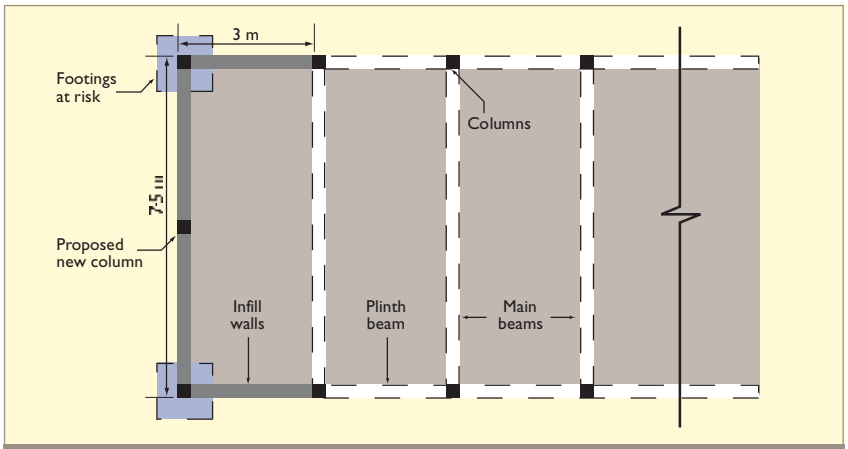

Fig. 16. Example of improving redundancy and robustness against foundation undermining, with corner infill walls, ground beams and additional end columns

at even the higher wave height of 4 m, experienced by the building in Fig. 15. The presence of well-constructed aprons around the building prevented scour in some cases. Ground beams also contributed towards preventing collapse despite the scouring.

Collapse due to foundation undermining can be prevented by providing well-constructed aprons around buildings and by increasing the formation depths of the corner column footings at least. Greater care during backfilling the foundation pits and/or soil improvement by using cement or lime are also measures that can be adopted; scour mats or geotextiles can be used too.

Building stiffness should be enhanced by the provision of ground beams and infill walls adjacent to corner columns. Redundancy should also be increased, at least on the building exterior, for example by introducing an additional central column in the transverse direction (Fig. 16). Once again these recommendations are

Fig. 17. Rail track ballast and embankments were completely washed away in places, leaving just the rails and sleepers

Fig. 18. Bridge approach embankments were often more vulnerable than the bridge structures themselves

incorporated in Sri Lankan reconstruction guidelines.[4]

Transport infrastructure

In some areas rail tracks and sleepers had been lifted off their ballast, and in others the entire railway embankment had been washed away (Fig. 17). Countermeasures could be the holding down of sleepers at intervals using embedded ties, and soil improvement for the embankment.

Most causeways were submerged by the tsunami. In reality, such causeways do not possess adequate lateral resistance to wave impact. In many places heavy scouring and partial sliding failure had occurred due to wave impact. The extension of wing walls along the roadside would reduce scouring. Also, the impact force could be reduced by increasing the opening for the passage of water—that is, increasing the length of the causeway.

In a few cases, bridge decks had been pushed off their bearings by the tsunami. Tying down the bridge decks to the substructure may not be the best option here, as the lateral loads will then be transferred to the piers and abutments, which may therefore also suffer damage. Accepting the loss of bridge decks while safeguarding the substructure and foundations may constitute a 'safe' mode of failure.[5]

The greater problem where bridges were concerned, however, was scouring near the abutments. Most abutments and piers had been constructed on piles carried to bedrock and hence did not collapse. However, the waves had attacked the backfilling adjacent to the abutments, causing damage to the roadway (Fig. 18).

Conclusions

Waves of up to 2 m in height caused 1–2 m high boundary walls to collapse. As wave heights increased, single-storey masonry structures were significantly damaged and were completely swept off their foundations at wave heights of around 4 m. Buildings of two storeys and higher, especially those with concrete frames, had their infill masonry walls that were perpendicular to the waves knocked down by waves of up to 4 m, but waves of even 5 m did not cause the complete collapse of such buildings. Partial collapse occurred, however, if foundations were undermined by waves of 3–5 m in height.

There are two common threads that run through the structural failures described above. The first is that structures have to be tied down in addition to being held up. The latter is obviously the focus of everyday attention, since gravity loads will assert themselves almost immediately otherwise. However, when natural disasters such as cyclones and tsunamis occur they have the effect of trying to lift up or push aside structures. Such actions can be resisted only by having a continuous chain of tying down from roof to foundation,[6] and also by having sufficient gravity load to resist the overall upward or lateral forces.

The second thread is that soil scouring has to be accounted for, or anticipated. This can be done by improving the soil properties, especially soil that has been backfilled; deepening foundations, whether in buildings or bridges; and also by providing sufficient structural redundancy to prevent catastrophic collapse even if some foundations fail. The strategic use of natural features such as sand dunes and provision of vegetation barriers are also ways of mitigating potential tsunami damage.

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What do you think?

If you would like to comment on this paper, please email up to 200 words to the editor at editor@ice.org.uk.

If you would like to write a paper of 2000 to 3500 words about your own experience in this or any related area of civil engineering, the editor will be happy to provide any help or advice you need.

LESSONS LEARNED FROM TSUNAMI DAMAGE IN SRI LANKA.

Proceedings of ICE. Civil Engineering.

PRE-LECTURA:

1. Lea el título del artículo. Subraye las palabras transparentes (cognados) para poder hacerlo. No se detenga en aquellas que no conoce. Luego trate de contestar:
   a. ¿Qué desastre natural es mencionado?
   b. ¿Sabe usted qué es un Tsunami?
   c. ¿Qué conoce usted sobre lo ocurrido en Sri Lanka on 26 December, 2004?
   d. ¿Qué tipo de información espera encontrar en éste artículo?

2. Ahora, lea la información ubicada debajo del título. (copete)
   a. ¿Qué puede comentar respecto a su tipografía?
   b. Subraye las palabras transparentes (cognados) que encuentra aquí.

3. Luego, lea las palabras clave ubicadas en el margen superior izquierdo de la primera hoja del artículo. Identifique cognados y relacione los mismos con lo leído anteriormente.
   a. ¿Qué otro desastre natural puede inferir que se relaciona con el Tsunami?
   b. ¿De qué elementos lexicales se valió para reconocerlo?

4. Lea los subtítulos y observe las fotos del artículo.
   a. ¿Cómo cree usted qué va a desarrollarse el mismo?
   b. ¿Cuál será la finalidad del artículo?
   c. Formule una primera hipótesis acerca del contenido del texto.

LECTURA DETENIDA

Vuelva a leer el texto.

1. Relea el primer párrafo y observe qué elementos paratextuales ayudan a comprender su significado; luego responda:
   a. ¿Qué parte de la costa fue la más afectada?
   b. ¿Qué tipo de olas generaron el desastre?
   c. Preste atención al conector **"However",** línea 5. Explique qué conceptos relaciona y qué tipo de relación establece.

2. Haga una lectura del segundo párrafo.
   a. ¿Cuál es la idea principal establecida allí?
   b. Ubique el término **"Hereafter**",línea 30. ¿Qué efecto tiene en el texto?
   c. Comente el uso de **"It"**, línea 45. ¿A qué palabras hace referencia?

3. Preste atención a las siguientes nominalizaciones:
   loading, línea 22; **overturning**, línea 47; **sliding**, línea 47; **scouring**, línea 48
   Las mismas se repiten sistemáticamente a lo largo del texto.Continúe leyendo con cuidado y márquelas con resaltador cada vez que aparecen.
   Asegúrese que comprende su significado. Use para ello los datos del co-texto. Tenga en cuenta su morfología.

4. El artículo menciona distintos tipos de estructuras. ¿Cuáles son? ¿Cómo se comportaron al ser afectadas por el Tsunami? ¿Qué modificaciones se proponen en el texto para aumentar la resistencia estructural de las mismas?
   -Complete el esquema, volcando esta información.

ESTRUCTURA	COMPORTAMIENTO DURANTE EL TSUNAMI	MODIFICACIONES SUGERIDAS

5. El artículo explica que la mayoría de las fallas estructurales se produjeron por dos problemas fundamentales. Diga cuáles son y explique qué hay que hacer para solucionarlos, según lo que leyó en el texto.

6. Durante la etapa de pre-lectura, usted formuló una hipótesis sobre el contenido del artículo y expresó cuál creía que era la finalidad del mismo. Ahora, está en condiciones de evaluar y decidir si su hipótesis fue correcta. Si no fue así, explique las diferencias y diga qué propósito persigue este texto.

RE-ELABORACIÓN:

1. Explique cómo se relacionan los conocimientos nuevos adquiridos al leer este texto con los conocimientos previos que usted ya poseía.

2. Haga un resumen del artículo en no más de 60 palabras.

3. Escriba la idea principal de este texto en una oración de síntesis.

REFLEXIÓN SOBRE LA LENGUA

1. Reciclemos conocimientos:

    - Ubique en el texto los distintos conectores que se presentan. Subráyelos .Explique qué conceptos relacionan, qué tipo de relación establecen y clasifíquelos según la misma en un esquema.

    - Encuentre en el texto ejemplos de conjunciones correlativas. Recuerde que estas palabras acompañan o enmarcan los conceptos que se suman o se ofrecen como opción. Explique qué función cumplen en cada caso.

    - Determine (con la ayuda del docente) de qué manera los conectores y las conjunciones correlativas ayudan a mantener la coherencia y la cohesión del texto.

Dry-cleaning turbines for high efficiency

Mitsubishi Heavy Industries' Turbo and Marine Machinery Design Department advise on the removal of combustion residues from turbo-charger nozzle blades.

The prevalent use of degraded fuel oils in running large marine diesel engines has led to reduced engine turbo-charger efficiency due to the accumulation of combustion residues on the turbo-charger turbine nozzle blades and moving blades.

Curbing the heavy fouling of the turbine nozzle and moving blades by cleaning them from time to time during the turbo-charger operation, therefore, has become a generally accepted practice.

The cleaning methods employed include wet cleaning with nozzle-sprayed water or dry cleaning by impingement of air-injected solid particles or a combination of both.

Instances of cracking

From the late 1970s to the early 1980s when Mitsubishi MET turbo-chargers relied on water washing for cleaning its turbines, there were instances of the turbine gas outlet guide, and gas inlet casing, cracking due to thermal shock caused by exposure to water. A cracked gas outlet guide and gas inlet casing are shown in Photos 1 and 2.

For successful turbine cleaning without damaging its components, therefore, the cleaning method for MET turbo-chargers was switched from wet cleaning to dry cleaning in the early 1980s. In making the switch, experimental studies were conducted between 1982 and 1983 aboard a ship in service. Two MET56S turbo-chargers were mounted on the ship's main engine had their turbines wet-cleaned and dry-cleaned respectively at intervals of about 200 to 300 hours of operation, roughly at the rate of once every ten days. This was to see if the dry-cleaning method would be as effective as the wet cleaning. Follow-up examinations were performed three times, about six months apart.

Both methods equally effective

The experimental studies showed that wet cleaning and dry cleaning were equally effective. Photos overleaf show external views of the wet-cleaned and dry-cleaned turbine nozzle blades and moving blades observed in the

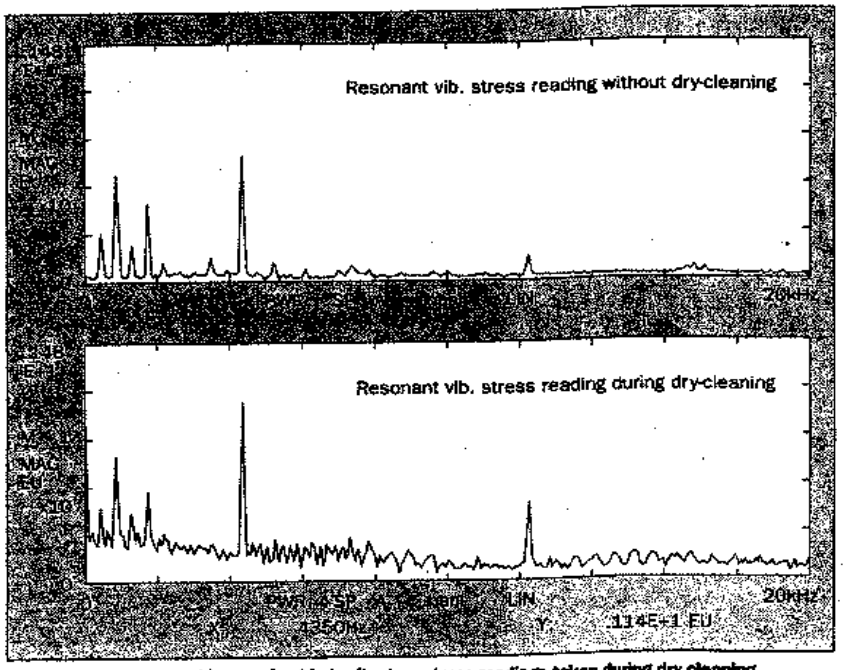


Fig 1: Turbo-charger turbine moving blade vibratory stress readings taken during dry cleaning.

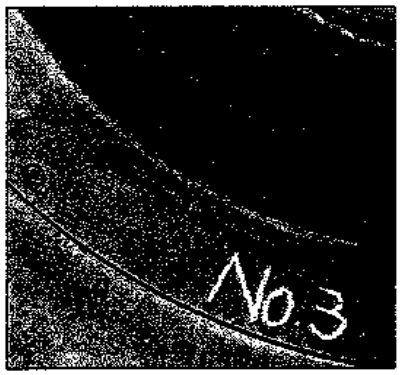


Photo 1 (top) shows cracking of turbine gas outlet Photo 2 (above) guide and gas inlet casing due to thermal shock caused by wet cleaning (washing with water).

TURBO-CHARGERS

No 1 turbo-charger (above): External views of turbine moving blades and nozzle blades (right) after dry cleaning.

two MET56S turbo-chargers in the second follow-up examination. As can be seen from the photographs, the nozzle blades show no appreciable differences in their appearances whether wet-cleaned or dry-cleaned though, when closely examined, the dry cleaning appears to outperform the wet cleaning in removing the fouling from the nozzle blade concave sides.

External views of turbine blades of the No 2 turbo-charger (above) and nozzle blades (right) after wet cleaning.

Neither cleaning method seems to have been effective enough to remove the fouling completely from the moving blades.

Evident to see, however, is the difference between the manner in which the fouling was removed by dry cleaning and wet cleaning, the dry-cleaned blade surfaces featuring nearly uniform and even removal of fouling and the wet-cleaned blade surfaces, although almost as clean, exhibiting a sign of the fouling having been removed as if peeled off locally along their concave-side trailing edges.

Taking all factors into consideration the dry-cleaned and wet-cleaned blade surfaces are considered to show no difference.

Dry cleaning recommended

Based on what was learned through the experimental studies, Mitsubishi has recommended to MET turbo-charger users the dry cleaning method as being more advantageous than wet cleaning. This is because dry cleaning, unlike wet cleaning, causes no thermal shock to the turbine components heated to high temperatures and thus ensures the safety of turbo-charger operation. In addition, the dry-cleaning system devised for application to MET turbo-chargers can be used routinely while under way with the main engine kept in normal-load operation. It was confirmed that the turbine moving blades, even when hit by injected dry-cleaning medium while rotating past the maximum critical speed, could remain safe against resonance-induced vibratory stresses. As shown in Figure 1, it was at the resonant frequency of 4 350Hz that the turbine blade vibratory stress reached its maximum from the effect of impingement of dry-cleaning medium. The vibratory stress in terms of absolute value, however, was considered to be at a safe level.

Negligible abrasive wear

The potential for the dry-cleaning medium causing abrasive wear of the turbine moving blades, nozzle blades, and gas outlet guide is considered to be almost nil. The dry-cleaning process only spans several tens of seconds each time. Besides, in view of the fact that the abrasive wear of the turbine components has been observed at times in MET turbo-chargers not employing the dry cleaning method, it is assumed that solid particulates contained in combustion residues are more to blame for such abrasive wear than the dry-cleaning medium.

When dry-cleaning the turbo-charger turbine, in order to prevent surging, the injection of an excessive quantity of dry-cleaning medium (in l/sec. or kg/sec.) at a time should be avoided. Also, emphasis should be placed more on preventing the build-up of heavy accumulations of fouling in the first place, because there are areas that are extremely difficult for the injected dry-cleaning medium to reach.

Information welcomed

Mitsubishi says that it is aware that the foregoing observations, being offered from its own viewpoint and experience of the MET turbo-chargers, may be challenged as being one-sided. Therefore, it would welcome any information which would complement its experience and knowledge to help it enhance its MET turbo-charger technology, the company says. ■

"DRY-CLEANING TURBINES FOR HIGH EFFICIENCY"

FIRST-READING TASKS

Getting ready to read: ***"Dry-cleaning turbines for high efficiency"***
Take into account the heading, subheadings, and accompanying visual aids of the text:

A- Answer

1) Say in your own words in Spanish or English what the author is probably informing the reader about. (Making predictions or guesses)
2) What do you already know about this theme? (Recalling/Activating prior knowledge)
3) What information related to your field of studies or professional activities would you like to find in this article? (Arousing interest or expectations)

B- Getting the gist of the article (Skimming)

1) For two or three minutes, skim through the text and find the main concepts or ideas in each of the paragraphs. Remember that in most cases they are at the beginning of paragraphs in what we call "key sentences''.
2) If possible in this quick approach, say what you think the author wants to convey in each of the units of information considered; thus confirming, rejecting, or readjusting the predictions you have made.

LANGUAGE FORMS

Now scan the text to:

1- Find Compound Adjectives; and then try a) to paraphrase them to make their meaning or use clearer, and b) explain the meaning of "dry-cleaning" with respect to "turbines" or "turbines for high efficiency"; (Some combinations to form adjectival compounds are in the following box:)
- Noun + -ing participle (= which does) e.g. **stress-bearing** structures; **water-cooling** pump

- Noun + -ed participle (= which is done by or through the agency of) e.g;
belt-driven device; **computer-assisted** navigation

- Adjective/Adverb + -ing participle (= does the action in the stated way or manner) e.g.
hard-working trainees; **ever-changing** computer technology

- Adjective/Adverb + -ed participle (= which is done in the stated way or manner) e.g.
quick-frozen food; **sexually-transmitted** diseases

2- Locate linking words or phrases used by the author to signal: Reason/Cause, Effect/Result, Purpose, Addition, Contrast, Concession and Condition. Explain briefly what you already know about the use or meaning of each of them.

READING

Now read the whole text. As you do it, try to infer the meaning or communicative value of the new words and expressions from the context first. Once you've done your best to understand them, check your guesses in your dictionary.

POST-READING TASKS (Reading for details and concepts)

Comprehension exercises

A- Understanding the passage

Decide whether the following statements are true or false by referring to the information in the text. Justify your decision. If one of them includes a concept which is partly true or false or is not stated in the passage, make necessary changes – adding, omitting or reordering data – so that it becomes true.

1- It has become a common practice to clean turbo-charger turbine blades in marine diesel engines by employing new cleaning methods.
2- Three decades ago, the use of water to clean Mitsubishi turbo-chargers led to cracking in some turbine components.
3- Experimental studies conducted to see whether different cleaning methods other than dry- cleaning were better could only be carried out when the ship was in dry dock being serviced.
4- The removal of the fouling from the blade surfaces by using one or the other method was found to be uniform and even, though not complete, in both cases.
5- The medium of the recommended dry-cleaning system should be injected with some limitations.

B- Understanding relations between parts of the text

-- Contextual Reference

Find out what things, people, facts, etc. the underlined words refer to.

1- . . . by cleaning them . . . (l. 8)
2- . . . damaging its components . . . (l. 25)
3- . . . This was to see . . . (l. 36)
4- . . . along their concave-side . . . (l. 73)
5- . . . reached its maximum . . . (l. 100)
6- . . . It was confirmed . . . (l. 92)
7- . . . that it is aware . . . (l. 128)

-- Logical development

Analyze the function of each of the following connective words and phrases in the text. What does the author want to signal in each case? Remember they can be used to express: Cause, Effect, Contrast, etc.

6- Therefore (l. 10)	10- Besides (l. 110)	14- though (l. 50)
7- However (l. 60)	11- due to (l. 4)	
8- Because (l. 83)	12- in order to (l. 119)	
9- Thus (l. 86)	13- In addition (l. 87)	

C- Providing the required information

Answer or do the following:

1- What are the combined causes of the reduction in the efficiency of marine diesel engine turbo-chargers?
2- What was the only cleaning method formerly used by Mitsubishi? Was it effective or not? Why?
3- What did this company do in order to assess the effectiveness of an alternative method?
4- What did a close inspection in the second follow-up examination reveal?
5- Compare the ways in which the fouling was removed by one and the other method.
6- Give more than one reason why MET turbo-charger users should employ the dry-cleaning method.
7- What may cause abrasive wear of the turbine moving blades, nozzle blades , and gas outlet guide?
8- What should be done for the dry-cleaning method to be highly effective?

D- Selecting and organizing information for presentation

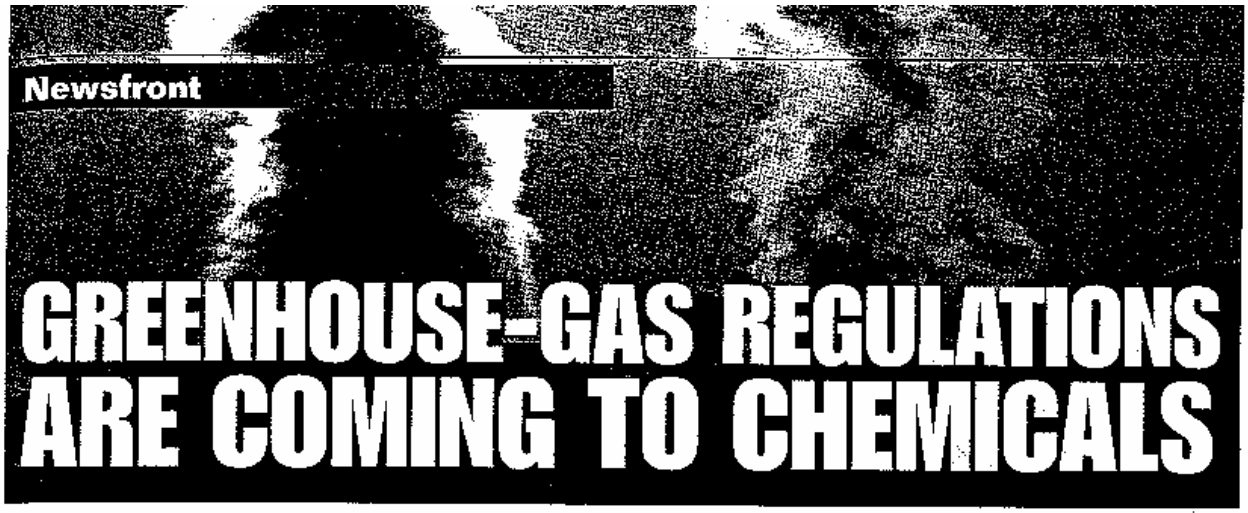
Imagine you're having an interview for a job offered by a leading ship-owner. It is a position which requires your professional expertise in dealing with maintenance or servicing problems on board.

As part of the interview, you've been asked to write out an account of what you would do and/or keep in mind in case you had to solve the problem of a recurrent heavy accumulation of combustion residues on turbine blades. Use this text as your only source.

So select information from it to refer to: causes, methods, experimental studies and their results suggesting the use of a particular method, pieces of advice, etc. Make up a two or three paragraphs text by using between 200 and 300 words in English or Spanish.

If you feel confident enough, you may present your work orally.

The best of luck with the interview!!



GREENHOUSE-GAS REGULATIONS ARE COMING TO CHEMICALS

When in 1997 a United Nations' conference at Kyoto, Japan, called into being the Framework Convention on Climate Change (UNFCCC), it seemed that greenhouse-gas emissions regulations were just around the corner. Not so fast, was the world's answer. The United States — after originally supporting the so-called Kyoto Protocol — turned around and rejected the treaty, which denied the majority it needed to enter into force. Nearly a decade passed without much action, except for ongoing bouts of serious politicking punctuated by arguments as to whether or not global warming is genuine.

But then, after being considered nearly dead earlier this decade, in 2005 the Kyoto Protocol finally was ratified. Although scientists took some years to reach consensus about global warming and lawmakers also took some years to decide what to do about it, suddenly the action phase is now underway. Not all decisions are yet final, but in Europe, regulation of greenhouse-gas emissions has already started.

To date the rules apply rather indirectly to chemical processes, but this is about to change. Probably in 2008 the European Union will regulate emissions of several greenhouse-gas chemicals, and controls most likely will be widened again in 2013. It took longer than expected, but at least in Europe, greenhouse gas regulations are coming to chemicals.

The Terminator takes aim... at global warming

Most likely, regulations also are coming to chemicals in the United States. Across a broad range of industry, senior managers are concluding that emissions rules are inevitable. Their common refrain: "That greenhouse gas regulations will be enacted in the U.S. is not a matter of if, but of when."

For some processes, the cost penalties may be significant

When, for the U.S. State of California, turned out to be September 2006. Governor Arnold Schwarzenegger signed into law Assembly Bill 32, the Global Warming Solutions Act, which will cap Golden State global warming emissions at 1990 levels by 2020 — the equivalent of a 20-25% reduction. Broadly speaking, California's legislation is similar to that of the European Union's, and it sets a precedent for the rest of the U.S. According to Van Ness Feldman, a law firm specializing in the field, "A.B. 32 is likely to have a significant influence on the national debate on establishment of a federal mandatory GHG emissions reduction program."

Clearly, regulations on emissions of CO_2 (plus, to a lesser extent, on the other greenhouse gases such as CH_4, N_2O and various fluorocarbons) are coming to the chemical industry — in Europe by the end of this decade and in the U.S. probably sometime thereafter. Should managers and owners of chemical companies be happy, worried or indifferent? Probably all of the above, depending on three main factors.

- 'Greenhouse intensity' of a company's products, i.e. the amount of CO_2 emitted in production. For some products, GHG caps could significantly harm cost competitiveness, while for others, it could significantly help. Moreover, this help or harm can be strongly influenced by a manufacturer's technical and commercial choices.
- Likelihood of GHG caps being applied. Caps will not be applied to all products or processes. For instance, the EU explicitly rejected caps for HFCs, because their emission sources are so numerous and diverse. Caps are unlikely to be placed on chemicals deemed to be either relatively insignificant or difficult to administer.
- Specifics of GHG caps. The value of carbon allowances is highly susceptible to manipulation by national governments that define GHG caps. No, this is not about cheating as such, but rather about completely legal options that can dramatically shift the costs of compliance.

These factors will combine differently for each chemical process. For some they will constitute a significant cost penalty, for others a major benefit and for many a minor impact. One angle of regulation, however, will affect almost all chemicals: benchmarking (see box, Why Benchmark GHGs?, p. 17).

Winners and losers

Given the current state of these three factors, the major subgroup of chemical producers likely to suffer from GHG caps would be chloralkali producers. Others who may suffer include makers of products via oxidation such as carbon black or acetylene. A beneficiary would be urea producers.

For instance, take the case of acrylonitrile. The manufacture of acrylonitrile has a carbon intensity of 1.4

Newsfront

CARBON DIOXIDE COST FOR ACRYLONITRILE PRODUCTION Quarter 2, 2005, U.S. Gulf Coast	
Sales price[1], $/ton	1,281
Cash cost[2], $/ton	1,155
Margin over variable cost (MOVC), $/ton	126
Total CO_2 emission tons CO_2/ton	1.4
CO_2 value @$30/ton (€25/ton)	42
CO_2 value as % of MOVC	33%

1. Price data from Platt's Petrochemical Report (average of April, May, and June 2005)
2. SRIC estimate

tons of CO_2 per ton of acrylonitrile. Let's assume that emissions credits will cost $30/ton (approximately €25/ton, the price around which the market fluctuated for much of the early part of 2006. Note: At the time of this writing, October 2006, the price is €13/ton). The table (above) shows the size of the carbon credit cost "hit" to the margin over variable cost (MOVC) of this process.

Using an SRIC estimate of cash cost and prices from Platt's Petrochemical Report we calculate the MOVC for acrylonitrile over the period in question at about $126/ton. But at $30/ton CO_2 the cost of credits is $42/ton — one-third of MOVC.

This example assumes that the manufacturer will have to purchase carbon credits on the open market to account for its carbon emissions. There are, however, many ways for carbon regulations to be applied that might mitigate the impact (e.g., grandfathering of existing capacity). Here, again, the likelihood and specifics of GHG caps are key.

Technology impacts

Greenhouse gas regulations also will give momentum to five other trends in chemical processing.

Catalyst and reactor design: Introduction of carbon regulation will put further pressure on the drive to maximize selectivity. This is likely to move the economic design optimum in the direction of modified catalysts, lower space-time yields, and larger reactors in order to obtain better selectivity.

Let's look at the straightforward example of ethylene oxide. For every mol of ethylene that is fully combusted, two moles of carbon dioxide are created. As the molecular weight of carbon dioxide is 44, this means that one ton of ethylene lost creates 88 ÷ 28 = 3.1 tons of carbon dioxide. At a nominal $30/ton CO_2 credit cost, this adds an extra $93/ton to the value of the ethylene lost in this fashion. While this cost is somewhat offset by the fact that some of the energy given off by the "burned" ethylene can be recovered as steam, the overall impact is still going to be strongly in favor of improving selectivity.

Improvements in feedstock utilization: Processes will see a move toward greater efficiency and feedstock utilization away from the reactor, too. One area may be the recovery of streams that are now rejected from the process. As carbon values go up that which is currently seen as uneconomic to recover will become more valuable.

Greater energy efficiency: The current effort, motivated by increased energy prices, to improve process energy efficiency will be accelerated by carbon regulation. Over time, as the effect of the regulatory regime rolls through the system, its affect will be that of a permanent price increase in energy. We expect to see even more of the plant energy conservation efforts that have been going on recently.

A shift away from electrochemical processes: Carbon regulation hits electricity prices harder than it hits fuel prices. This occurs for two reasons. One is that at most locations a significant fraction of the electrical mix is coal-fired and, thus, more carbon intensive than most chemical plants that run on gas or oil. The other has to do with the thermodynamic losses associated with power generation. We expect that carbon regulation will raise the price of electricity over the long term. This will accelerate the exit of some electrochemically driven processes from the scene.

A shift towards biorefineries: Enzyme and other process technologies are improving for some of the bio-based routes to commercially desirable products. While the biorefinery concept is still a ways off, the well-to-product lifecycle carbon cost incurred by the usual conventional process chain can really add up. This should provide another motivation, along with the current high price of crude oil, to move from our traditional synthetically-derived chemical value chain to a bio-based one. Over time, perhaps within 10 years, we may see significant inroads into some end uses by biobased products.

Movement of high electrical intensity processes to locations with low carbon electrical mix: As CO_2 regulation is phased in and electrical utilities are forced to buy carbon credits to offset their emissions they will pass those costs on to their customers in the form of higher prices for electricity. The price increases will be higher in locations where coal dominates the generation mix and smaller where there is more nuclear, hydroelectric, and alternative generation. This is likely to result in migration of electrically intensive processes, e.g. chlor-alkali, to these lower carbon (and thus lower electrical cost) locations. ■

WHY BENCHMARK GHGS?

Perhaps one of life's most misery-inducing experiences, for most people in the U.S., is the process of filling out income tax declarations. But there is a positive side to them: at least one is able to figure out how much is due. Imagine if the government simply demanded payment according to its private, inflated estimates of what one earned and owed!

This then, is also the rationale behind benchmarking greenhouse gas emissions. Rather than letting a government hold all the cards (or emissions figures), benchmarking allows companies, regulators and verifiers to estimate emissions — rapidly, at a modest cost, and in a standardized way.

To provide an independent, authoritative set of benchmarks, SRI Consulting has developed the 2006 Greenhouse Gases Handbook. Greenhouse gas emissions (GHG) factors for 100 chemical processes are presented. The selection of processes and products emphasizes three areas: basic petrochemicals, processes with significant carbon intensities, and the ethylene supply chain. For details, see https://www.sriconsulting.com/GHG/ □

Authors

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GREENHOUSE-GAS REGULATIONS

A- <u>ANTICIPATE THE CONTENT OF THE TEXT</u> (you can answer in Spanish or in English)

1) Read title, subtitle and paragraph headings – what do you expect the text to be about?
2) Other than the introduction, how many sections does the article have? Number them (intro = 0)
3) Read the first sentence in each paragraph in section I and identify past / present / future events. Now read the title again and decide the time the article will probably refer to
4) Have a quick look at section II – how is it different from section I? What words signal the difference?
5) Read the first sentence in section III and the words in bold type("negrita") at the beginning of each paragraph. How do you think section III differs from section I?

B- **<u>NOW READ THE TEXT IN DETAIL</u>**

1) Find the following acronyms in the text, give line number and explain
SRIC MOVC GHG A.B. UNFCCC
Give five other acronyms in English (preferably technical ones)

2) Answer or do the following. GIVE LINE REFERENCE

1. Why weren´t the regulations enforced earlier?
2. Where will they be enforced first?
3. What will the 20-25% reduction mean?
4. What chemicals may not be covered by the regulations?
5. Read the first paragraph in section II and mention a "winner".
6. Look at the box on page 2.
7. What is benchmarking compared to? Why is it convenient?
8. Read the last 2/3 lines in each paragraph in section III. Choose two possible results of the regulations and state them in Spanish.

3) **Go over the text again.** Find and translate into Spanish three nominal constructions(adjectives may be included) of each of the following kinds:

1. Two words (e.g. cost penalties)
2. Three words (e.g., significant cost penalty)
3. Can you find any nominal constructions with more than three words?

4) **Find out what the following words refer to**:

Line 24 it
Line 45 their
Line 109 they
Line 199 its
Line 206 it

5) **Prepare a presentation** with information about the history of the regulations, their present state in both the Unites States and Europe, and the impact they may have.

Drive Maintenance

On The Road To Peak Performance

Of all the hardware components that make up a PC, the hard drive probably requires the most ongoing maintenance. However, many computer users are often lax about providing it. That's a mistake. A typical hard drive filled with 25GB of digital content most likely contains 70,000 to 80,000 individual files. The integrity of each and every one of those files depends on the integrity of the drive as a whole.

Three For Free

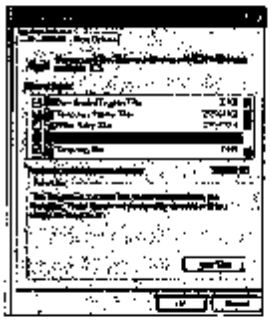
You can maintain a healthy hard drive with minimal effort and at no cost. All you need are three drive maintenance utilities that come bundled with Windows: Disk Cleanup, Check Disk (known as ScanDisk in previous versions of Windows), and Disk Defragmenter. Each of these handy utilities performs a unique service for the drive, ensuring that it continues operating as it should and that every file on the drive—make that every individual bit of data on the drive—is accounted for and in its rightful place. This is an important job. If even one bit fails, you could lose access to a favorite digital snapshot, tomorrow's homework assignment, the sales presentation for that big client you're trying to land, or—in a worst-case scenario—Windows itself.

Disk Cleanup. Believe it or not, the first IBM PC to reach the market in 1981 did not include a hard drive as part of its standard configuration (hard drives were available as an option). IBM added hard drives as standard equipment to its second-generation machines, but those drives had a measly 20MB maximum capacity.

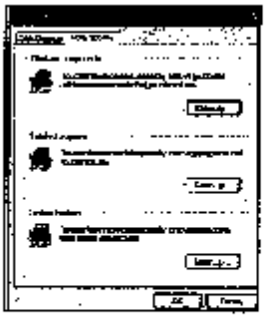
With such limited storage space, users had to exercise great discretion when choosing the programs and files they wanted to save on their computers. The rationing of storage space was a common practice among active computer users for the next 15 years or so, until popularly priced multigigabyte drives reached the market in the late 1990s. Ever since, users have felt little compulsion to restrict the amount of content they add to their PCs. They fill their drives with downloadable software they never use, audio files they never listen to, and whatever other unnecessary content catches their fancy.

What's wrong with that? In a certain sense, nothing at all. Drives were designed to be filled with data and can function just as well at 80% capacity as at 20% capacity. Nevertheless, the accumulation of extraneous content tends to have a negative affect on drive efficiency and performance.

How? Consider the process of buying a hotdog and a soda from a concession stand at a football game. Imagine how easy it would be for you to do so an hour before the game when the stadium is mostly empty and the concessionaires are waiting anxiously for fans to arrive. Now, imagine how different the situation would be if you tried to get your snacks at halftime when the stadium is a sea of body-painted humanity and the lines for refreshments are even longer than the lines to the restrooms. It's a similar situation with a hard drive. Every piece of information contained on a drive has a dedicated address so Windows knows where it is at all times. Windows can access and retrieve your content quite easily when your data consumes only a fraction of the drive's capacity. But it takes measurably longer for Windows to access



Disk Cleanup automatically removes large blocks of unnecessary files from your system. We recommend eliminating whatever Disk Cleanup selects by default.



In addition to helping you remove installed programs and Windows components, Disk Cleanup lets you eliminate old System Restore points. We advise against this, as you never know when you might need to revert to an earlier system configuration.

that same content if the OS (operating system) first has to sort through piles of temporary files, orphaned folders, and other superfluous data.

The Disk Cleanup utility in Windows can help you eliminate the unnecessary code that litters your hard drive. To access the utility in Windows XP Home, open the Start menu and select All Programs (Programs in Windows 98/Me), Accessories, and System Tools. Click Disk Cleanup and wait for the utility to open. Open the Disk Cleanup tab of the resulting dialog box. You have the option of selecting various file types for removal, including Downloaded Program Files, which are files associated with the Java and ActiveX programs that run automatically when you view particular Web pages; Temporary Internet Files, which are copies of Web pages you recently visited; Recycle Bin, which contains recently deleted files; and Temporary Files, which are files that keep track of changes made to open documents. You can safely select and delete all of these files. You also have the option to compress old files. By selecting this option, you give Disk Cleanup permission to compress files that you haven't recently accessed. The files remain on your PC but consume less storage space. We recommend choosing this option every time you use Disk Cleanup.

After making your selections, click OK and then click Yes to remove the files from your PC. A progress indicator may appear and track the progress of the cleanup. The utility closes automatically when the cleanup is complete.

Now access Disk Cleanup again. Open the More Options tab when the Disk Cleanup dialog box appears. Under Installed Programs, click the Clean Up button to access the Add Or Remove Programs utility. Review the list of currently installed programs and remove any title you no longer use. Reboot your system and repeat until you have eliminated all unused software. Next, return to the More Options page of the Disk Cleanup utility. Under Windows Components, click the Clean Up button to launch the Windows Component Wizard. Follow the instructions to determine which Windows components are installed on your computer. Remove any that you do not use. When the process is complete, reboot your PC.

Disk Cleanup will not eliminate all of the unnecessary code that exists on your system. It does not recognize invalid Registry settings and redundant data files, for instance. However, the utility will get rid of the biggest offenders and prepares your hard drive to take the next step toward good drive maintenance.

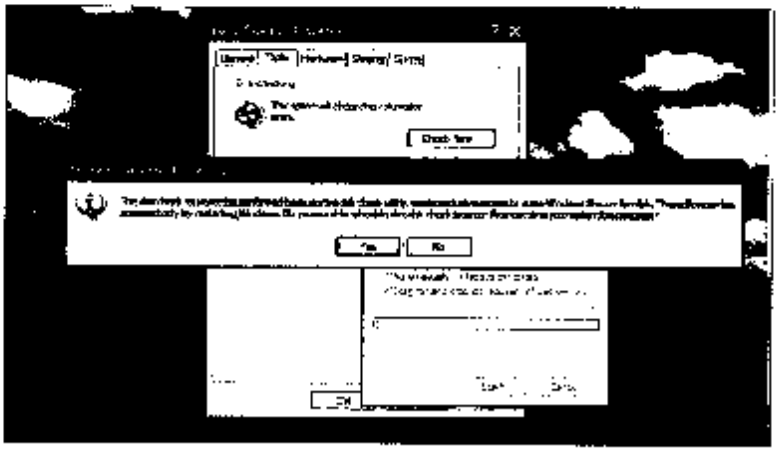
Check Disk. Known as ScanDisk in previous versions of Windows, the Check Disk (CHKDSK) utility in WinXP Home scans the selected hard drive for disk errors that put your data at risk. Check Disk can identify and quarantine bad sectors (portions of a drive platter that are unable to hold data), for instance, so that Windows will not write data to them. It also tries to resolve minor file system errors, such as cross-linked files (a mix-up that occurs when the file system tries to load two unique pieces of data into one address location on the hard drive) or lost clusters (a mix-up that occurs when the file system loses the address location of a data segment), which may occur as a result of an improper shutdown or general wear and tear.

Check Disk is an automated utility that requires very little input from the user. To access it, open My Computer and locate the icon for the hard drive in

Scheduled Maintenance: Dates To Remember

The key to successful drive maintenance is knowing when to perform each maintenance task. The following chart provides some general guidelines. You may need to perform the tasks more often if your PC gets a heavy workout every day.

Task	Frequency
Scan for viruses and spyware *(Perform a full-system virus scan at least once each week.)*	Continuous
Uninstall unwanted programs	As often as necessary
Clean out extraneous files and folders	Once every week
Check the drive for disk errors	Once every two weeks or month
Defragment the hard drive	Once every six months or year



Close all open programs before launching Check Disk. If the utility determines that files are open and in use elsewhere, it will stop immediately and request that you restart the computer before it proceeds.

question. Right-click the icon and select Properties from the menu. Select the Tools tab and click the Check Now option under the Error-Checking heading. Select both the Automatically Fix File System Errors and the Scan For And Attempt Recovery Of Bad Sectors options (in WinMe, select the Thorough and Automatically Fix Errors options) and then click the Start button. For best results, make sure you close all applications before running the utility. The utility cannot perform a thorough check of the drive if the drive is active.

Once launched, Check Disk immediately begins to search the hard drive for trouble spots. It should perform any repairs automatically. If it gives you the option of repairing a problem or ignoring it, choose to repair it. During a repair, the utility will attempt to recover any readable data contained within the bad sectors and move it to good sectors so that you can access the data at a later time. The utility may give you the option of saving the data it couldn't recover, but there is little point in doing so. The unrecoverable data is nothing more than digital mishmash. You're better off recovering the lost data from a backup file (you do have a backup, right?).

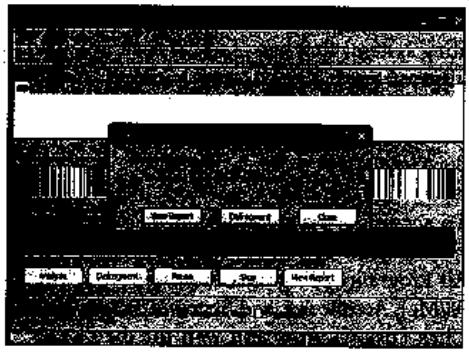
We should point out that Check Disk has its limits. It can rectify minor mistakes but cannot undo major mishaps, such as the deletion of a necessary file or the corruption of the **MBR (master boot record;** a record of how data is organized on the hard drive). If Check Disk finds numerous errors each time you run it, take heed: The errors could portend a crash. If you encounter two or more errors on subsequent scans, back up your data immediately and contact the drive manufacturer to obtain diagnostic software that can reveal more details about the current health of the drive.

Disk Defragmenter. The preceding utilities, Disk Cleanup and Check Disk, focus on drive sanitation. They eliminate the accumulation of gunk, whether it was put there on purpose (for example, programs and data files) or by accident (for example, drive errors). In contrast, Disk Defragmenter focuses on drive organization.

When Windows writes data to a hard drive, it assigns it to a particular spot on a particular disk. This spot is known as a data address. Windows strategically assigns data addresses for efficient retrieval. The system works well until you start removing old data and moving data from bad sectors to good sectors. The data then becomes fragmented on the drive, with inefficient gaps separating islands of data scattered across the magnetically charged platters. This leads to poor drive performance.

You can get a better understanding of how fragmentation affects drive performance by once again comparing it to our scenario of the concession stand at a football game. Consider the beverage vendors. These vendors have to carry their heavy drink trays much further if the fans are scattered throughout the stands rather than if the fans all sit together in one section. Similarly, it takes longer for a hard drive's read/write heads to locate and retrieve data from a fragmented platter than to locate and retrieve the data from a well-organized platter.

Disk Defragmenter organizes the drive by rearranging the data for the most efficient access and retrieval. It eliminates gaps, works around bad sectors, and realigns data into contiguous sections of the drive. To access the utility in WinXP Home, open the System Tools folder (via the Start menu, All Programs, Accessories) and click the Disk Defragmenter shortcut. Click the Analyze button and wait while it checks the drive's fragmentation status (the analysis should take place automatically in WinMe and other previous versions of Windows). Disk Defragmenter will indicate whether a defragmentation is necessary. If it is, click the Defragment button. The defragmentation can take an hour or longer, depending on the size of your drive. For best results, close all open applications while Disk Defragmenter is running.



Disk Defragmenter will analyze your drive and indicate whether a defragmentation is necessary. Whatever the analysis recommends, we suggest defragmenting the drive at least once per year.

What Else?

Disk Cleanup, Check Disk, and Disk Defragmenter represent three important drive maintenance tasks you can perform on a regular basis. They're not the only drive maintenance utilities, however. We recommend around-the-clock scanning for viruses, spyware, and other malicious content. Invest in an up-to-date antivirus utility and a reputable antispyware utility if you haven't done so already.

You also should periodically peruse the contents of the hard drive for the bits and pieces of digital detritus that build up over time. Empty the Temporary folders, review the contents of the Program Files folder for outdated references to uninstalled applications, and delete invalid shortcuts. You may even want to consider running a third-party Registry cleaner or uninstall utility that delivers a deep cleaning to a dirty system. By making drive maintenance a priority, you ensure that your PC runs smoothly and efficiently long into the future.

BY JEFF DOOD

DRIVE MAINTENANCE

Smart Computing Reference Series: PC How-Tos: It's Time To Reinstall Your Operating System. Reference Series Volume 10, Issue 6. 2006.

BEFORE YOU READ THE TEXT

1. Glance through the text, and consider the following questions:
    a. What type of text are you about to read?
    b. Where was it published?
    c. Are you familiar with this type of publication?

2. Now look at the title and figures, what do you expect to read about?

3. Scan the text and sketch the organisation of the article.

READ THE TEXT IN MORE DETAIL

1. Concentrate on the way the information is organised under the subheading "Check Disk".
    a. Can you divide this section further?
    b. Can you apply the same organisation to the other sections of the text?

2. What does the author think about the way people usually maintain their computers? Why?

3. How is *Disk Defragmenter* different from *Disk Cleanup* and *Check Disk*?

4. How can drive maintenance help computer users?

5. Imagine you have been asked to brief your workmates on improving computer performance. You have thought of condensing the relevant information into a table and of circulating an email with it. Use the headings below to synthesise the information.

Utility	Use/Function	Author's recommendations	Limitations

6. Can you perform any other task to enhance the way your computer runs?

NOW LET'S ANALYSE SOME LINGUISTIC AND STYLISTIC FEATURES

1. Notice the use of **( )** in lines 166-177. What is their function? Could the author have used any other device for the same purpose?

2. Now check the use of **( )** in lines 236-239, and lines 286-288. Have they been used in the same way?

3. The author includes a brief historical account (lines 34-54) and an analogy (lines 66-81 and lines 259-268) in the article. What is the function of each? How important is it to understand each of these sections?

4. Using the line reference given, look back in the text and find the reference for the words in italics.
    a. With *such* limited storage space… (line 43)
    b. Ever *since*… (line 52)
    c. What's wrong with *that*? (line 59)
    d. However, *the utility* will get rid of the biggest offenders…(line 156)
    e. …but there is little point in doing *so*. (line 211)

5. Using the line reference given, look back in the text and try to work out what the words in italics mean in this context.
    a. …that come *bundled* with Windows. (line 16)
    b. …but those drives had a *measly* 20MB maximum capacity. (line 42)
    c. …the accumulation of *extraneous* content… (line 64)
    d. …but cannot undo major *mishaps*…(.line 219)
    e. They eliminate the accumulation of *gunk*… (line 235)

LET'S NOW REFLECT ON WHAT WE HAVE READ.

1. Have you had any experiences with the processes described? Share them with the rest of the class.

2. In your own words summarise the author's advice.

Hydrogen Fuel Cells

DOE Hydrogen Program

Overview

Hydrogen is a versatile energy carrier that can be used to power nearly every end-use energy need. The fuel cell — an energy conversion device that can efficiently capture and use the power of hydrogen — is the key to making it happen.

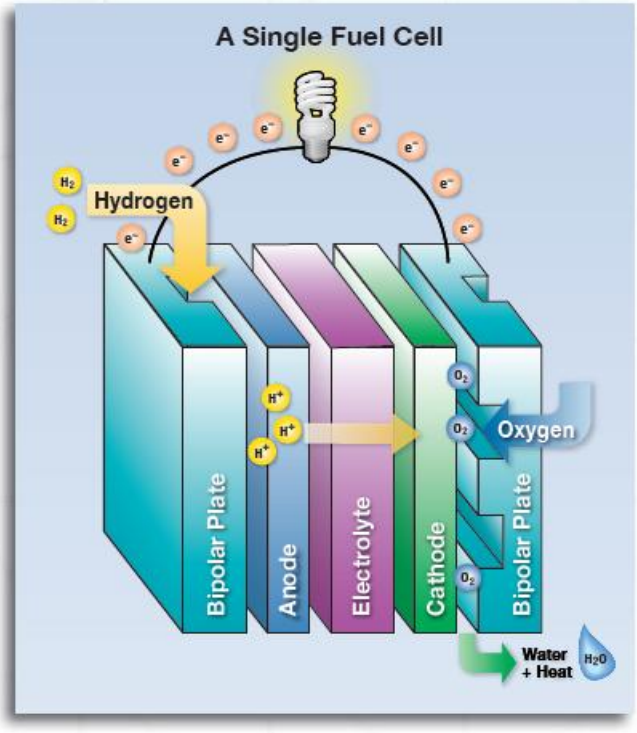
- Stationary fuel cells can be used for backup power, power for remote locations, distributed power generation, and cogeneration (in which excess heat released during electricity generation is used for other applications).
- Fuel cells can power almost any portable application that typically uses batteries, from hand-held devices to portable generators.
- Fuel cells can also power our transportation, including personal vehicles, trucks, buses, and marine vessels, as well as provide auxiliary power to traditional transportation technologies. Hydrogen can play a particularly important role in the future by replacing the imported petroleum we currently use in our cars and trucks.

Why Fuel Cells?

- Fuel cells directly convert the chemical energy in hydrogen to electricity, with pure water and potentially useful heat as the only byproducts.
- Hydrogen-powered fuel cells are not only pollution-free, but also can have two to three times the efficiency of traditional combustion technologies.
  - A conventional combustion-based power plant typically generates electricity at efficiencies of 33 to 35 percent, while fuel cell systems can generate electricity at efficiencies up to 60 percent (and even higher with cogeneration).
  - The gasoline engine in a conventional car is less than 20% efficient in converting the chemical energy in gasoline into power that moves the vehicle, under normal driving conditions. Hydrogen fuel cell vehicles, which use electric motors, are much more energy efficient and use 40-60 percent of the fuel's energy — corresponding to more than a 50% reduction in fuel consumption, compared to a conventional vehicle with a gasoline internal combustion engine.
- In addition, fuel cells operate quietly, have fewer moving parts, and are well suited to a variety of applications.

How Do Fuel Cells Work?

A single fuel cell consists of an electrolyte sandwiched between two electrodes, an anode and a cathode. Bipolar plates on either side of the cell help distribute gases and serve as current collectors. In a Polymer Electrolyte Membrane (PEM) fuel cell, which is widely regarded as the most promising for light-duty transportation, hydrogen gas flows through channels to the anode, where a catalyst causes the hydrogen molecules to separate into protons and electrons. The membrane allows only the protons to pass through it. While the protons are conducted through the



U.S. Department of Energy Hydrogen Program
www.hydrogen.energy.gov

membrane to the other side of the cell, the stream of negatively-charged electrons follows an external circuit to the cathode. This flow of electrons is electricity that can be used to do work, such as power a motor.

On the other side of the cell, oxygen gas, typically drawn from the outside air, flows through channels to the cathode. When the electrons return from doing work, they react with oxygen and the hydrogen protons (which have moved through the membrane) at the cathode to form water. This union is an exothermic reaction, generating heat that can be used outside the fuel cell.

The power produced by a fuel cell depends on several factors, including the fuel cell type, size, temperature at which it operates, and pressure at which gases are supplied. A single fuel cell produces approximately 1 volt or less — barely enough electricity for even the smallest applications. To increase the amount of electricity generated, individual fuel cells are combined in series to form a stack. (The term "fuel cell" is often used to refer to the entire stack, as well as to the individual cell.) Depending on the application, a fuel cell stack may contain only a few or as many as hundreds of individual cells layered together. This "scalability" makes fuel cells ideal for a wide variety of applications, from laptop computers (50-100 Watts) to homes (1-5kW), vehicles (50-125 kW), and central power generation (1-200 MW or more).

Comparison of Fuel Cell Technologies

In general, all fuel cells have the same basic configuration — an electrolyte and two electrodes. But there are different types of fuel cells, classified primarily by the kind of electrolyte used. The electrolyte determines the kind of chemical reactions that take place in the fuel cell, the temperature range of operation, and other factors that determine its most suitable applications.

Fuel Cell Type	Operating Temperature	System Output	Efficiency	Applications
Alkaline (AFC)	90–100°C 194–212°F	10kW–100kW	60–70% electric	• Military • Space
Phosphoric Acid (PAFC)	150–200°C 302–392°F	50kW–1MW (250kW module typical)	80–85% overall with combined heat and power (CHP) (36–42% electric)	• Distributed generation
Polymer Electrolyte Membrane or Proton Exchange Membrane (PEM)*	50–100°C 122–212°F	<250kW	50–60% electric	• Back-up power • Portable power • Small distributed generation • Transportation
Molten Carbonate (MCFC)	600–700°C 1112–1292°F	<1MW (250kW module typical)	85% overall with CHP (60% electric)	• Electric utility • Large distributed generation
Solid Oxide (SOFC)	650–1000°C 1202–1832°F	5kW–3 MW	85% overall with CHP (60% electric)	• Auxiliary power • Electric utility • Large distributed generation

Source: Argonne National Laboratory

**Direct Methanol Fuel Cells (DMFC) are a subset of PEMFCs typically used for small portable power applications with a size range of about a subwatt to 100W and operating at 60–90°C.*

Challenges and Research Directions

Reducing cost and improving durability are the two most significant challenges to fuel cell commercialization. Fuel cell systems must be cost-competitive with, and perform as well or better than, traditional power technologies over the life of the system.

Ongoing research is focused on identifying and developing new materials that will reduce the cost and extend the life of fuel cell stack components including membranes, catalysts, bipolar plates, and membrane-electrode assemblies. Low cost, high volume manufacturing processes will also help to make fuel cell systems cost competitive with traditional technologies.

For print copies of this fact sheet, please call the DOE Energy Efficiency and Renewable Energy Information Center at 877-EERE-INF(0)/877-337-3463.

Did you know...

Hydrogen is an energy carrier, not an energy source, meaning that it stores and delivers energy in a usable form.

Hydrogen can be produced using abundant and diverse domestic energy resources, including fossil fuels, such as natural gas and coal; renewable energy resources, such as solar, wind, and biomass; and nuclear energy.

Using hydrogen as a form of energy can not only reduce our dependence on imported oil, but also benefit the environment by reducing emissions of greenhouse gases and criteria pollutants that affect our air quality.

The President's Hydrogen Fuel Initiative accelerates the research and development of fuel cells and hydrogen production, storage, and delivery infrastructure technologies needed to support hydrogen fuel cells for use in transportation and electricity generation.

Under the President's Hydrogen Fuel Initiative, the DOE Hydrogen Program works with industry, academia, national laboratories, and other federal and international agencies to overcome critical technology barriers, address safety issues and facilitate the development of model codes and standards, validate hydrogen fuel cell technologies in real world conditions, and educate key stakeholders who can facilitate the use of hydrogen and fuel cell technology.

Increase Your H2IQ!
Visit **www.hydrogen.energy.gov**

October 2006

PRE-READING TASKS: ANTICIPATION

1. Read the title and identify two concepts.

2. Read the bibliographical data at the bottom. Where was it taken from? What type of article are you going to read? Is it technical or semi-technical? Does it come from a reliable source, do you think? Why?

3. Read only the first sections "**Overview**" and "**Why fuel cells?**" Search for words or phrases related to the two concepts mentioned and complete the following chart. Concentrate on ONE concept at a time. Write in English or Spanish.

4. Using the words in the chart above, write a reading hypothesis.

_____

_____

_____

READING TASKS: COMPREHENSION AND VERIFICATION

1. Read the complete text. Tick the information you can find in the text and underline it.

- La confiabilidad y el tamaño de las celdas de combustible como desafíos para su comercialización.
- Caracterización y aplicaciones de la celda de combustible de membrana de intercambio protónico.
- Ventajas y desventajas del uso de cada tipo de celda de combustible.
- Funcionamiento de las celdas de combustible de carbonato derretido.

- Caracterización del hidrógeno.
- Aportes de la presidencia norteamericana para la iniciativa del hidrógeno como combustible.
- Factores ambientales del uso de las celdas de combustible.

2. Make the necessary changes to the sentences above (the ones that you did not find in the text) so that they match the information in the text.

3. The text presents five sections (with subtitles) and a section entitled "Did you know?" Search for nominal constructions and connect them with each section. Sometimes a word or phrase can go with one or more section. The first has been done for you.

Overview	Hydrogen – a versatile energy carrier – the fuel cell – an energy conversion device – stationary fuel cells – backup power – a particular role in the future - portable generators – transportation technologies – the imported petroleum – our cars

Suffixes:
Suffixes are very useful when you want to determine the **categories of words:**

1. develop**ment**/durabil**ity**/happi**ness***/conver**sion**/pollu**tion**/social**ism***/citizen**ship*** → nouns
2. employ**ee***/teach**er***/conduct**or** → nouns (people or instruments)
3. chemic**al**/fam**ous***/norm**al**/sunn**y***/use**ful**/brown**ish***/use**less***/competit**ive**/driv**ing**/ power**ed**/ suit**able**/ → adjectives

* not in the text

4. Work in groups. Choose a section from the text and analyse the nominal constructions you found in that section. Use this chart. An example has been done for you.

Pre-modifiers					Noun head	Post-modifiers
article	poss adj.	adjective	noun	participle		
a		versatile	energy		carrier	

4. a) Translate the nominal constructions of your chart into Spanish.

5. Share your chart and the translations with the other groups.

AFTER-READING TASKS: INTERNALIZATION AND REFORMULATION

1. Imagine that you are doing research on fuel cells. You are possibly reading lots of articles and you need to remember them all. For that you will probably need to make a synthesis of the article. Choose one of the following activities to make a synthesis:
    a. Write ONE well-written sentence.
    b. Make a mind-map (Mapa conceptual)

2. Reflection: What exercise(s) helped you in order to do this last activity? In what ways?

RESILIENCE REPORT strategy+business
Booz Allen Hamilton Inc

The Art of Underengineering

by Christian Koehler and Robert Weissbarth

Design-driven cost reduction allows manufacturers to realize savings of 10 to 30 percent for products in development.

1.Companies waste billions of dollars every year on new product enhancements that consumers do not want, cannot use, or will not pay for. The fact is that most new products, from automobiles to washing machines, are overengineered.

2.But corporate efforts to rein in excessive engineering costs frequently fail. CEOs and CFOs at manufacturing companies tell the same story: To achieve a margin on new products, engineers know they need to hit a target cost, but somehow **they** don't. Why not? Engineers argue they need to spend more to meet consumers' expectations.

3.This problem is especially acute in the automotive industry, where consumers have come to expect much more for less. In the past, vehicle manufacturers got around the problem of meeting consumer demands without raising costs by putting pressure on suppliers. But the returns on **this strategy** are diminishing, because today's automotive suppliers, struggling to survive, have no more margins to squeeze.

Design-Driven Cost Reduction

4.There is an alternative: design-driven cost reduction, a methodology for taking out cost by modifying the product design of both current products and products in development. Design-driven cost reduction is especially important in the automotive industry, but **it** can be applied to nearly all manufactured products.

5.For most assembled products, including automobiles, the cost of components and materials from suppliers typically accounts for 40 to 60 percent of the final price. To protect their margins, manufacturing companies continually chip away at costs. Automotive companies generally rely on purchasing departments to cut costs by 3 percent a year; at a company with sales of $100 billion spending $40 billion on raw materials, that could mean $1.2 billion in annual savings. In practice, **they** are lucky to achieve 1 to 2 percent reductions.

6.On average, 70 percent of the cost of any new product is fixed by the specifications and design. In other words, more than two-thirds of the total cost is designed into the product. By identifying what is integral to an automobile's appeal and what is an expensive waste, manufacturers can modify the product design to dramatically reduce unit costs and give consumers the products **they** want at competitive prices.

7.In practice, realizing savings through design is extremely challenging. Most cost-reduction initiatives that attack the design process don't stick, no matter whether the ideas come from a "value analysis" (taking out cost without compromising value) of an existing product or a "value engineering" approach to designing a new product. Resistance to new ideas also keeps design changes from being implemented.

Idea Owners

8.Although value analysis and value engineering can identify potential savings, true design-driven cost reduction does much more. **It** combines idea generation with analysis to establish clear targets for cost savings. It sets a timetable to ensure fast action and infuses collaboration and flexibility into the implementation process. It is cross-functional; it can be customized for specific engineered products; and it embraces commercial as well as technical improvements. Engineers become "idea owners" and are held accountable for a cost reduction proposal from beginning to end.

9.Using design-driven cost reduction, manufacturers can achieve an additional 3 percent annual savings for current products; savings can reach 10 to 30 percent for products in development. The European division of one global vehicle manufacturer introduced design-driven cost reduction in 2001. A team of 200 engineers generated and evaluated ideas to take cost out of product design. **This co-located group,** which reported directly to top management, was freed of other responsibilities to focus exclusively on the effort. (Previous cost-reduction programs were part-time projects and lacked management support and targets.) The result: cost savings of more than $400 million over the first 30 months. Similar programs at another manufacturer have yielded 20 percent savings in three years.

10.Design-driven cost reduction has four cornerstones:

• **Process discipline** is imposed at every stage: idea generation,

evaluation and prioritization, and implementation through production. Each step has an expected duration, and every idea is tracked. A highly disciplined approach to validation and implementation ensures that the cost benefits are realized in the shortest possible time.

• **Target setting and transparent reporting** add to the discipline. Targets for cost reduction are derived from competitive benchmarking, component by component.
Suppliers play a valuable role here in assessing cost differences. Transparent reporting ensures that deviations from targets are quickly corrected.

• **A cross-functional organization** that removes organizational barriers — physical and cultural — is essential to fostering collaboration. Soft management issues, especially culture change, play a vital role in reducing natural conflicts among engineering, purchasing, and marketing.

• **Management commitment** empowers design-driven cost reduction teams to make and implement difficult decisions. Key supporting management roles include setting targets, reviewing progress, removing roadblocks, and supporting critical decision trade-offs among product cost, weight, performance, and functionality.

11.Design-driven cost reduction is not a panacea. But it is a powerful management resource to help companies realize better margins — not at the expense of their suppliers and customers, but through better design that benefits everyone.

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UNDERENGINEERING

TASKS

I. PRE-READING

1. Look at the title and subtitle.
   a. What do you think the word "underengineering" refers to?
   b. Is the word "art" commonly associated with engineering topics?
2. How is the article organized? Read the paragraph headings and try to identify definitions and m concepts.
3. What do you know about the authors of the article?
4. What do you expect the article to be about?

II. READING

1. Vocabulary:

Read the article in detail and match these words with their meaning in the context:

1. Enhancement	a. something fundamentally important
2. To rein in	b. produce, give
3. To get around	c. remove or withdraw gradually
4. To squeeze	d. inspire, fill with
5. To chip away	e. improvement
6. Integral	f. stop or check
7. To infuse	g. extract by pressure
8. To yield	h. bypass, avoid
9. To foster	i. concession, exchange
10. Cornerstone	j. intrinsic, essential, constituent
11. Trade off	k. encourage, promote

2. Contextual reference:

Say what these words/ phrases refer to in the context

PARAGRAPH	LINE	
2	9	**they** don't
3	10	**this strategy**
4	9	But **it** can be …
5	16	**they** are lucky …
6	13	**they** want …
8	5	**It** combines …
9	14/15	**This co-located group** …

3. Underline the most important word in each of these phrases. Then, translate the whole phrases into Spanish:

1. design-driven cost reduction
2. purchasing departments
3. cost-reduction initiatives
4. a highly disciplined approach to validation
5. soft management issues
6. key supporting management roles

4. Paraphrasing:

Rewrite these sentences from the text in some other way without changing the original meaning. Pay attention to the relations between ideas established by linking words:

*(paragraph 2)
To achieve a margin on new products, engineers know they need to hit a target cost, but somehow they don't.

*(paragraph 8)
Although value analysis and value engineering can identify potential savings, true design-driven cost reduction does much more.

*(paragraph 8)
… it embraces commercial as well as technical improvements.

5. Comprehension questions:

1. What is the cost problem manufacturers are facing?
2. What do these figures from the article stand for?

- 40 to 60 %
- 3%
- $1.2 b
- 1 to 2 %

- 70 %
- 10 to 30 %
- 2001
- 200

3. In which paragraph do you think the main idea of the article is stated?
4. What are the reasons why realizing savings through design turns out to be such a challenging task?
5. How did car manufacturers get around the problem of satisfying consumers' demands at low cost in the past?
6. Why isn't this strategy effective any more?
7. How much of the total cost of a new product do design specifications account for?
8. How was the design-driven cost reduction program introduced in 2001 by the European division of a global vehicle manufacturer different from previous programs?
9. After reading the article carefully, what do you think the term *underengineering* refers to? Can you confirm the prediction you made in task 1a, Pre-reading stage?

III. RECONSTRUCTION

1. Write a summary of the article in no more than 90 words.

2. You are the Purchasing Manager in a multinational car manufacturing company. Prepare a presentation about "The art of underengineering". Your audience will be engineers from the different sectors of the firm.

http://www.cse.wustl.edu/~jain/cis788-97/ftp/satellite_nets/index.htm

Radio Communications

"This paper is to give an overview of the history and increasingly important role of communication satellites in the world of telecommunications." David Hart. 2003

The launching of the first satellite by the Russians in 1957 began what has become known as the 'space race', the first stage of which culminated with the Americans landing on the moon twelve years later. A whole range of satellites now orbit the Earth and are used for a variety of purposes.

Low orbit satellites, the typical height of which varies from 150 to 450 kilometres, are of little use for telecommunications for they are only in line of sight of each earth station for about 15 minutes. Their rotation period around the Earth is about one and a half hours and their main use is for remote sensing, a field in which digital processing techniques are proving especially valuable. A low orbit satellite, equipped with a multispectral scanner system (MSS), can observe the Earth in great detail providing us with extremely accurate information about agriculture, forestry, water resources and pollution patterns. It also has a multitude of applications in such fields as weather forecasting, environmental monitoring, geology, oceanography and cartography. There are important defence implications too, since they can be used to 'spy' on the activities of a potential enemy.

Medium altitude satellites are used for telecommunications, especially in countries which cover a vast geographical area like the USSR. They 'fly' at a typical height of 9 000 to 18 000 kilometres, orbiting the Earth in a period of five to twelve hours. They are in line of sight of the earth station for between two and four hours.

The most important type of satellite for telecommunications is the **geosynchronous**, or **geostationary**, **satellite** positioned over the Equator at a height of 35,800 kilometres. Its rotation period is 24 hours, the same as the Earth's, and consequently, seen from the Earth, this type of satellite appears to remain motionless in the sky. It is within line of sight of an earth station for its entire life.

A **communication satellite** is, in essence, a microwave relay station which receives signals in a given frequency band and retransmits them at a different frequency to avoid problems of interference between the weak incoming signal and the powerful retransmitted signal. The equipment which receives a signal, amplifies it, changes its frequency and then retransmits it, is called a transponder. A satellite can handle large amounts of traffic which it can send over vast areas of the Earth.

It therefore represents a relatively cheap way of transmitting information over long distances. For countries which do not already have sophisticated cable or microwave networks the use of a satellite can be extremely beneficial as it can be used in their place.

The first satellites were seen as a way of communicating with people who lived in isolated areas of the world. As a result, earth stations began to appear in the remotest parts of the globe. The cost of satellite communication began to fall steadily and, consequently, satellites have to compete with submarine cables as a way of linking continents cheaply. With the arrival of optical fibre undersea cables, however, a more balanced division of intercontinental circuits between the two is likely. Satellites were soon used to broadcast TV programmes 'live' from one side of the Earth to the other, and then to link up computer terminals in different parts of the world. The use of digital transmission and multiplexing techniques has led to an enormous increase in the capacity of satellites.

The international organization **INTELSAT** was created in 1964 to provide international communication services by satellite. In 1983 it operated and owned 16 spacecraft in geosynchronous orbit representing an investment of over three billion US dollars. In 1983 it handled two thirds of all international telephone and data communications and transmitted virtually all 'live' international television broadcasts. One hundred and nine nations are members of **INTELSAT**. Between 1979 and 1983 **INTELSAT's** traffic doubled, yet its communications charges decreased,

despite a 73% rise in the worldwide cost of living index.

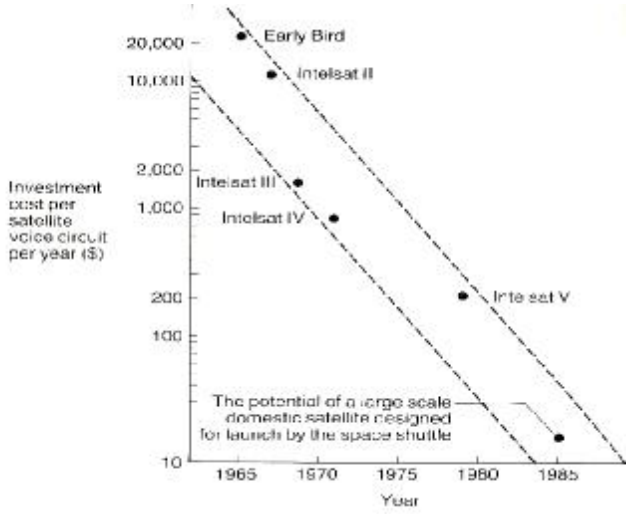

Fig. 1 ***The falling investment cost of satellite voice circuits***

A series of **INTELSAT** satellites has been launched; the table below gives the main characteristics of the **INTELSAT** satellites.

Evolution of INTELSAT Spacecraft

SERIES	I Early Bird	II	III	IV	Va	VI
First launch	1965	1967	1968	1971	1983	1986
No. of voice circuits	240	240	1200	6000	24 000	80 000
Bandwidth MHz	25	130	225	36	2570	3262
No. of transponders	2	1	2	12	27	50
Design lifetime (years)	1.5	3	5	7	7	7–10
No. of artennae	1	1	1	3	7	7
Weight in orbit (in kg)	38	87	146	703	950	2243

Fig. 2

Satellites are not simply replacements for point-to-point terrestrial lines. They have several unique properties, among which the most important are:

- a 270 millisecond propagation delay caused by the distance the signal has to travel (80 000 km-300 000 km/sec = 0.27 seconds)

- the possibility of very high bandwidths or bit rates if the user can avoid local loops by having an antenna on his premises, or a radio link to an earth station antenna.

- the special security problems that are posed when information is broadcast through a satellite.

Until recently all satellites were launched using rockets which proved to be extremely costly as the rockets were lost in the sea a few minutes after being launched. The space shuttle, itself put into orbit by a rocket, parts of which are recovered and can be reused, heralds the era of routine access to space, for one individual shuttle will be able to perform not less than 100 separate missions. Its payload is also greater than that of any previous rocket's and its crew will be made up not only of professional astronauts but of scientists who will be able to conduct their research in the gravity-free environment of space.

NASA, the U.S. space organization, is the main agency in the world for launching satellites. NASA's two and three stage Titan rockets safely launched all ten Gemini manned spacecraft, as well as numerous satellites.

E.S.A., the European space agency, has produced the Ariane launch vehicle as a rival to Titan. For a 1.2 tonne geostationary satellite an Ariane launch costs $30 million, compared to $75 million by Titan. However, although it is more costly, Titan is also more reliable with 119 successful launches out of 122.

The Ariane consists of three stages, each of which is a pair of fuel tanks with one or more rocket engines. The fuel from the two tanks burn when mixed in the engine. The large first stage lifts, the vehicle through the atmosphere, and when the fuel tanks are empty the section falls away, igniting the second stage. The process is repeated by the second stage, then the third stage, which carries a computer and directional equipment in its front end, and manoeuvres the satellite into position.

Expendable launch vehicles such as Titan and Ariane now face strong competition from NASA's new generation of re-usable "Space Shuttle" launch vehicles. Although the cost of a shuttle is as high as a billion dollars, the aeroplane like spacecraft is designed to go into orbit repeatedly, thus reducing the cost of launching a satellite to around $16 million.

The space shuttle is launched with the aid of two booster rockets and an external fuel tank. When the boosters are no longer needed they fall to earth by parachute, to be picked up from the sea and used again. Later the fuel tank is released, but this is not recovered. Once In orbit, the orbiter uses its own engines to manoeuvre. After the mission the shuttle re-enters the earth's atmosphere and lands on a runway in the same way as an aircraft.

RADIO COMMUNICATIONS

EXERCISES

1. COMPREHENSION EXERCISES

1.1 Main ideas

a) Which two of the following subjects do you think the author deals with in this text.

1. To build space stations.
2. Use of rockets for launching satellites.
3. Description of the Ariane and the Titan.
4. A world service telecommunications system.
5. Role of satellites in modern communications.

b) Answer these questions.

1- Is it possible to have today worldwide communications? Why/why not.
2- How are satellites put into orbit?

1.2 Questions on the text

(1) Which was the starting point of satellite launching?
(2) Do low orbit satellites have great use in telecommunications? Why/not?
(3) What is the main use medium altitude satellites offer to man?
(4) Why does the geosynchronous satellite appear to be motionless in the sky?
(5) What can a communication satellite be compared to?
(6) Which three ways of communication does the author mention and compare?
(7) What was INTELSAT created for?
(8) What special features do satellites have?
(9) What do NASA & ESA stand for?
(10) Which is the cheapest way to launch a satellite? Why?

1.3 True / False Exercise

- Low orbit satellites are specially useful for remote sensing.
- Low orbit satellites cannot be considered a defence weapon.
- The geostationary satellite is positioned over the Equator line.
- The geostationary satellite is in line of sight of the earth station for 2 or 4 hours.
- A transponder only amplifies the signal.

1.4 Find and give the information

- The year in which INTELSAT was created.
- The year in which the Early Bird was launched.
- How long was INTELSAT II expected to last?
- How many antennae did INTELSAT IV have?
- The reason why using rockets to launch satellites is highly expensive.

1.5 Locating information

- It takes about one hour and a half for low orbit satellites to rotate around the earth.
- Scientists regarded the first satellites mainly as a system of communication.
- Communication satellites can be very useful in those countries lacking developed technology.
- Digital transmission increases satellite capacity.
- Only one shuttle is needed to launch 100 communication satellites.

2. VOCABULARY EXERCISES. UNDERSTANDING WORDS

2.1. Synonyms / Antonyms

Refer back to the text to find **synonyms** for the following words:

1- provide (lines 1 to 5)
2- putting into orbit (lines 1 to 8)
3- kind (lines 20 to 25)
4- deal with (lines 30 to 35)
5- useful (lines 35 to 40)

Refer back to the text to find **antonyms** for the following words:

- nearest (lines 40 to 45)
- disappearance (lines 40 to 45)
- small (l. 45 to 50)
- less than (l. 50 to 55)
- least important (l. 55 to 60)

2.2. Matching words

Match each word in **A** with the meaning in **B** that comes closest to it:

A	B
Main	Created
Range	Increase
Rise	Principal
Unique	Special
Founded	Variety

2.3. Content Review

Find words with this meaning in the text.

1) Rocket used to give initial speed to a missile, after which it drops and leaves the missile to continue under its own power.

2) The planet on which we live.

3) Object for relaying back to the earth telephone messages, radio o TV signals.

4) Band of frequencies within which signals from a transmitter must be kept to prevent interference.

5) Outline from which something will be made.

2.4. Replacing terms

Choose a word or phrase from the text to replace the underlined word

- The first satellites were regarded as a way of communication with people who lived in far-away areas in the world.
- The following table gives the main characteristics of the INTELSAT satellites.
- Satellites are not simply replacements for point-to-point earth lines.
- The Ariane is composed of three stages.

3. TEXT ORGANIZATION

3.1. Linking words

A -Choose one of the words below & fill in the blanks. There are some extra words.

but — and — when — nevertheless — for — such as — as if — in order to

- INTELSAT was formed in 1964 _____ operate and maintain the global satellite communication system.
- There are several space agencies _____ NASA & ESA.
- The early bird had two transponders _____ INTELSAT IV had twelve.
- _____ we compare the Ariane and the Titan, we will see the Titan is more expensive _____ it is more reliable as well.
- The boosters fall to the earth by parachute _____ they are no longer needed.

B- Look for the different linking words used in the text & classify according to what idea they express.

LINES: 10- 11 – 16 (2) – 18- 26 – 32 – 35 –37 – 40- 42 – 44 – 46 – 50 –53 – 55 – 72 – 74 (2) – 79 – 82- 86/87- 88- 91- 93 – 94 – 98 – 99.

Idea / concept of:

- **Addition**: _____
- **Giving examples**: _____
- **Reason**: _____
- **Consequence**: _____
- **Time sequence**: _____
- **Contrast**: _____

3.2. Contextual Reference.

Look back at the text & find out what the words in **bold** typeface refer to:

1- The first stage of **which** (l. 5)
2- Height of **which** (l. 8)
3- **Their** main use (l. 11)
4- **It** also has (l. 15)
5- **They** fly (l.20)
6- **Which** receives signals (l. 29)
7- In 1983 **it** operated (l. 50)
8- **Its** communications (l. 55)
9- Among **which** (l. 60)
10- **which** proved (l. 68)

4. SUMMARY SKILLS

4.1 Text summary

Refer back to the text & choose the five most important points from this list in order to get a summary.

1. Intelsat had only two thirds of all international telephone communications.
2. The first manmade satellite was launched in 1957.
3. One hundred and nine nations are members of Intelsat.
4. The world needs a telecommunication system.
5. The shuttle system reduces the cost of satellite launching.
6. It is possible to control a satellite from an earth station.
7. Intelsat organizes satellite launching.
8. Expandable launch vehicles now face strong competition.
9. The use of satellites in today's world communications is a must.
10. Rockets are used for putting the communication satellites into orbit.

4.2 Schematic representation of data

Make a table listing the satellites & another one listing the rockets mentioned in the text, adding in each case relevant information (e.g. date of launching, nationality, etc.)

The Accuracy Controlled Enterprise:

Moving from Quality Conscious to Accuracy Controlled Production and Maintenance

Abstract

Moving from Quality Conscious to Accuracy Controlled Production and Maintenance. Highly reliable equipment is necessary to reduce production costs and maximise production throughput. High reliability from operating equipment requires high quality reassembly, coupled with the correct operating practices. You can guarantee correct maintenance and proper plant operation by specifying a target and tolerance in maintenance and operating procedures. Having a target and tolerance sets the recognised acceptance criterion. A simple proof-test will confirm if it has been met. Specifying a mark and tolerance range changes the focus from one of simply doing the job; to now doing the job accurately. This results in high quality trades' workmanship and sound equipment operator practices that deliver reliable equipment performance. Those organisations that use 'target, tolerance, proof-test' methodology in their procedural tasks move from being a quality-conscious operation to being an Accuracy-Controlled Enterprise (ACE).

Keywords: standard operating procedure, SOP, accuracy-controlled enterprise

1. Do you know that your workforce can prevent nearly all plant and equipment breakdowns! If your maintenance people do their work accurately to design specification, and your operators run the equipment precisely as intended, they can make the equipment work so well that it becomes superbly reliable.
2. There is no need to be doing repairs sooner than required by the design if the equipment is rebuilt accurately and runs correctly. Accuracy is defined as "the degree of conformity of a measured or calculated value to its actual or specified value." To have accuracy you need a target value and a tolerance of what is acceptably close to the target to be called accurate.
3. How many defects, errors and failures can your operation afford to have each day? Does your maintenance crew have the time to go back and do a job twice or three times because it was done wrong the first time? Are people happy to regularly accept wasted production and lost time due to stopped equipment? If not, then do your internal work procedures support doing the job right the first time?
4. Highly reliable production equipment running at 100% design capacity should be normal and natural. Your plant and equipment was designed to work reliably. Its maintenance was intended to sustain the design reliability. Its operation should be as the designer anticipated. The designer wanted reliable 100% rate production.
5. If under operation you are not getting the reliability designed into the equipment, then something is amiss. The challenge becomes to identify what is preventing the equipment from delivering the performance it was designed to give.
6. Very occasionally the fault lies with the design itself. Typically the wrong material was selected for the job. Either it was not strong enough for the stresses induced in it or it was incompatible with materials coming in contact with it. Once a design problem is identified the necessary change is made to enable the equipment reliability to rise to the design intent.
7. Much more often the reason equipment does not meet its designed reliability is because it is installed wrongly, it is built or rebuilt poorly and it is operated not as designed. Usually this happens because people involved in its installation, care and running do not know the right ways.
8. Though most operators and maintainers have some recognised training it can never be enough to competently handle all situations. In those situations where they have not been trained they are forced to use what knowledge they do know to make a decision. If it's the wrong choice and no one corrects them, it becomes the way they solve that problem again in future. The Start of Defects, Failures and Errors in Your Business
9. Unfortunately many decisions of this type do not have an immediate bad impact. If they did, it would be good, because the worker would instantly self-correct and get it right. No, most errors of choice or

ignorance do not impact until well into the future. The chosen action was taken and nothing bad occurred. Which meant the operator or tradesman thought it was the right decision, since things still ran fine. That is how bad practices become set-in-place in your operation.

10. There is nothing wrong with making a wrong decision. Provided it is corrected immediately and nothing bad happens, there was no harm done. Bad things happen when bad decisions are allowed to progress through time to their natural and final sad conclusion. Regrettably there are very few decisions that will give you instant replay options.
11. If it is important in your company to have low maintenance cost, highly-reliable production equipment, then your internal work systems must support that outcome. All work done by operators, maintainers, engineers and managers need to go right the first time.

Why We Have Standard Operating Procedures

12. Companies have long recognised that if you want consistent, reproducible, correct results from your workforce they need to work to a proven and endorsed procedure. The procedure provides clear guidance, sets the required standard and stops variations in work performance.
13. Variations in work performance arise because human skills, talents and abilities are typically normally distributed. If we were to gauge the abilities of a wide cross-section of humanity to do a task, we would end up with a normal distribution bell curve. Secondary and tertiary learning institutions are well aware that student results follow a normal distribution curve. A normal Gaussian distribution bell curve of a talent in a large human population is shown in Figure 1.

14. The implication of such a distribution is that for most human skills and talents there are a few exceptionally able people, a few with astoundingly poor ability and lots of people in-between clustered around the middle or mean.
15. If your workplace requires highly able people to make your products and do your maintenance, then from the distribution curve of human talent you are going to find it hard to get many people who are that good. The ones you do get will cost you a lot of money because they are the elite in the industry. Hence standard operating procedures were created to use people from the around the middle and below ability levels to do higher standard work than they naturally could do unassisted.
16. The talent distribution curve also explains why the continual training of your people is so important to your company's long term success. If the available labour pool is clustered around the mean performance level of a skill, then a good way to improve the population's ability to do the skill is to teach them how to do it better. Training has the effect of moving average performers toward the elite portion of the population. This is shown in Figure 2.

The Cost of Poorly Written Standard Operating Procedures

17. Since standard operating procedures (SOPs) control the quality of the work performed by people not expert in a task, they are clearly absolutely critical to the proper running of a business. It is also critically important that they are written in ways to promote maximum efficiency (make use of the least resources) and effectiveness (done in the fastest correct way).
18. It has been my experience that very few companies use their SOPs to control outcomes. When they are available they are not self-checking and do not promote good practice. They offer little practical assistance to the user. Typically they are glanced over when operators and maintainers start a new job and then thrown to the back of the shelf to never be seen again. That is a pity because they are one of the most powerful learning tools ever developed. At least they could be if their supervisors and managers knew what could be done with an SOP.
19. Of the companies that have SOPs, most were written by their resident expert in the job. They wrote the procedure already knowing all the answers. So tasks were described with words and statements that assumed prior knowledge. You will often see in SOPs statements such as -"Inspect lights, check switch, check fuse, and test circuit". And "Inspect steering wheel linkage". Or in the case of a machine operator - "Test the vehicle and report its condition".
20. The problem with the use of procedures containing such descriptions is that you must first be an expert to know whether there is anything wrong with what you are looking at. They require you to hire trained and qualified people in order to do what is maybe a very simple job.

The Best SOPs Can Be Done By The Least Skilled People.

21. There is a better way to write SOPs that still maintain the work quality but do not need only qualified people to do them. They can be written with more detail and guidance and include a target to hit, a tolerance on accuracy and regular proof-tests of compliance so that job quality is guaranteed.
22. Standard operating procedures are a quality and accuracy control device which has the power to deliver a specific level of excellence every time they are used. Few companies understand the true power of an SOP. Typically they are written because the company's quality system demands it. People mistakenly write them as fast as they can, with the least details and content necessary.
23. In reality SOPs should be written to save organisations time, money, people and effort because they can make plant and equipment outstandingly reliable so production can maximise productivity!
24. For a standard operating procedure to have positively powerful effects on a company and its people there must be clear and precise measures, which if faithfully met, will produce the required quality to deliver the designed equipment performance. Great production plant reliability and production performance will naturally follow!
25. If we take the "Inspect steering wheel linkage" example from above and apply the 'target, tolerance, proof' method, a resulting description might be:
26. "With a sharp, pointed scribe mark a straight line directly in-line on both shafts of the linkage as shown in the accompanying drawing/photo (A drawing or photo would be provided. If necessary you also describe how to mark a straight scribe mark in-line on both shafts). Grab both sides of the steering linkage and firmly twist in opposite directions. Observe the scribe marks as you twist. If they go out of alignment more than the thickness of the scribe mark replace the linkage (a sketch would be included showing when the movement is out of tolerance)." The procedure would then continue to list and specify any other necessary tests and resulting repairs.
27. With such detail you no longer need a highly qualified person to do the inspection. Anyone with mechanical aptitude can do a reliable inspection. This method of writing procedures is the same as used by writers of motor car manuals for novice car mechanics. Car manuals are full of procedures containing highly detailed descriptions and plentiful descriptive images. With them in-hand novice car mechanics can do a lot of their own maintenance with certainty of job quality.
28. The very same logic and method used to write car manuals also applies to industrial production and maintenance procedures. If you put in your procedures all the information that is necessary to rebuild an item of equipment, or to run a piece of plant accurately, you do not need people from the exceptional end of the population to do the job well.

Train and Retrain Your People to Your Standard Operating Procedures

29. Having a procedure full of best content and excellent explanations for your workforce is not by itself enough to guarantee accuracy. How can you be sure that your people comprehend what they read? Many tradesmen and plant operators are not literate in English, nor do they understand the true meaning of all the terms used in a procedure.
30. To be sure your people know what to do and can do it right, they need to be trained in the procedure and be tested. Training is needed before they do the task alone, without supervision, and later they need refresher and reinforcement training. The amount and extent of training varies depending on the frequency a procedure is done, the skill level of the persons involved and their past practical experience in successfully doing the work.
31. Procedures done annually or more often by the same people will not need retraining. Because people forget, those procedures on longer cycles than annually will need refreshment training before they are next done.
32. Training and retraining often seems such an unnecessary impost on an organisation. You will hear managers say "If the work is done by qualified people why do I need to train them? They have already been trained." The answer to that question is "How many mistakes are you willing to accept?"
33. For example, if you have had flange leaks soon after a piece of equipment was rebuilt, it is a sign that you may need to retrain you people in the correct bolting of flanges. Flanges do not leak if they were done right. When a repair re-occurs too often, it is a signal that the SOP does not contain targets, tolerances and proof-tests or that training is needed to teach people the procedure.

Taking Your Organisation to an Accuracy Controlled Enterprise

34. A classic example of what great value an accuracy-focused SOP can bring is in this story of a forced draft fan bearing failure. The rear roller bearing on this fan never lasted more than about two months after a repair. The downtime was an expensive and great inconvenience. To take it out of the realm of a breakdown, the bearing was replaced every six weeks as planned maintenance.
35. The bearing was also put on vibration analysis condition monitoring observation. After several replacements enough vibration data was collected to diagnose a pinched outer bearing race. The rear bearing housing had been machined oval in shape when manufactured and it squeezed the new bearing out-of-round every time it was bolted up.
36. You could say that vibration analysis was applied wonderfully well. But the truth is the repair procedure failed badly. If there had been a task in the procedure to measure the bolted bearing housing roundness and compare the dimensions to allowable target measurements, it would have been instantly noticed as having an oval shaped hole at the first rebuild.
37. There was no need for the bearing to fail after the first time! A badly written procedure had let bad things happen! Whereas an accuracy-controlled procedure with targets, tolerances and proof-tests would have found the problem on the first repair and it would have been fixed permanently.
38. You can convert existing ISO 9000 quality procedures to accuracy-controlled operating procedures with little development cost. The only extra requirement is that you include a target with tolerances and a proof-test in each procedural task to give feedback and confirmation the task is done right.
39. The problem with targets is that they are not easy to hit dead-centre. It is not humanly possible to be exact. If a procedural task states an exact result must be achieved, then it has asked for an unrealistic and virtually impossible outcome. A target must be accompanied with a tolerance range within which a result is acceptable. There must be upper and lower limits on the required result.
40. Even the bulls-eye in an archery target is not a dot; it is a circle with a sizable diameter. You can see the bulls-eye in Figure 3 is not a pin prick in size. Anywhere within the bulls-eye gets full marks. So must be the target for each task in an accuracy-controlled procedure. Figure 3. Targets Have Tolerances

41. A well written accuracy-controlled procedure contains clear individual tasks; each task has a measurable result observable by the user and a range within which the result is acceptable. If you do this to your procedures you build-in accuracy control. With each new task only allowed to start once the previous one is within target, you can guarantee a top quality result if the procedure is followed as written.
42. With targets set in the procedure, its user is obliged to perform the work so that they hit the required target. Having a target and tolerance forces the user to become significantly more accurate than without them. When all the task targets are hit accurately, you know the procedure was done accurately!
43. Once a procedure always delivers its intended purpose you have developed a failure control system. No longer will unexpected events happen with work performed accurately to the procedure.

Conclusion

44. ocedures need in-built accuracy to prevent failure and stop the introduction of defects. To ensure each task is correctly completed the worker is given a measurable target and tolerance to work to. The procedure is done correctly when its individual tasks are all done to within their target limits. Using this methodology in standard operation procedures makes them quality control and training documents of outstandingly high value and accuracy.
45. The organisations that use sound failure control and defect prevention systems based on proof-tested, accurate work, move from being a quality conscious organisation to being an accuracy-controlled enterprise, an ACE organisation.
46. With that level of accuracy in maintenance, operation and engineering tasks you will naturally get outstanding equipment reliability and consistently high production performance.

Mike Sondalini

Lifetime Reliability Solutions

"Profit from Operational and Maintenance Excellence." 20-03-08

During a professional engineering career starting in 1985 when we graduated from Curtin University with First Class Honours, he has held project engineering and maintenance engineering positions at the Swan Brewery in Perth, Western Australia, and was Maintenance Manager at Coogee Chemicals, a mid-sized Australian industrial and mining chemical manufacturer. He gained an MBA from the University of Western Australia in 1993. Through his consultancy 'Lifetime Reliability Solutions' he specialises in identifying and analysing production, manufacturing and operations problems, then solving them by using a variety of financial modeling and asset management methodologies.

TASKS

I. **PRE-READING**

1. Read the title, subtitle and abstract. What do you think the article deals with?
2. How is the article organized?
3. Are the graphs clear enough?
4. Scan the article to trace the word accuracy and all its derivatives throughout the article. What do you think the main idea could be?
5. Read the first paragraph. Who do you think the article is addressed to?
6. What is the purpose of the author in your opinion?
7. What do you know about the author?

II. **READING**

A. COMPREHENSION

-- CONTEXTUAL REFERENCE What do these words and phrases refer to in the text?

PARAGRAPH

1 they …….
4 its ……....
6 it ……....
7 its ……...
8 them ……...
9 Which …….
11 it ……...
14 such a distribution ……
17 they ……..
18 they ……..
22 it ……..
33 it ……..
39 which ……....

-- **COMPREHENSION QUESTIONS:** Read part Why We Have Standard Operating Procedures and answer:

What do the workforce have to follow if correct results are the aim of a company?

I. Why are there variations among different performers of a task?
II. Why was it necessary to create SOPs?
III. How can average performers be moved to the elite part of the population?

B. LANGUAGE/GRAMMAR

-- CONDITIONAL SENTENCES

Read the following conditional sentences from the text and say what kind of idea is expressed in each case:
a) a general fact that is always true;
b) something probable in the present/ future;
c) something unreal or contrary to present facts;
d) something that happened (or not) in the past and is regretted.

1. If under operation you are not getting the reliability designed into the equipment, then something is amiss.
2. There is nothing wrong with making a wrong decision. Provided it is corrected immediately and nothing bad happens, there was no harm done.
3. If it is important in your company to have low maintenance cost, highly-reliable production equipment, then your internal work systems must support that outcome.
4. If we were to gauge the abilities of a wide cross-section of humanity to do a task, we would end up with a normal distribution bell curve.
5. If your workplace requires highly able people to make your products and do your maintenance, then from the distribution curve of human talent you are going to find it hard to get many people who are that good.
6. That is a pity because they are one of the most powerful learning tools ever developed. At least they could be if their supervisors and managers knew what could be done with an SOP.
7. If we take the “Inspect steering wheel linkage” example from above and apply the ‘target, tolerance, proof’ method, a resulting description might be: …
8. If there had been a task in the procedure to measure the bolted bearing housing roundness and compare the dimensions to allowable target measurements, it would have been instantly noticed as having an oval shaped hole at the first rebuild.

Now try to find more examples in the text and underline them.

-- NOUN PHRASES

Give the Spanish equivalent of the following noun phrases from the text:

1. The Accuracy Controlled Enterprise
2. Quality Conscious Production and Maintenance
3. ....sound equipment operator practices
4. …. high quality trades' workmanship
5. . ..'target, tolerance, proof-test' methodology
6. …. Standard Operating Procedures
7. …. Poorly Written Standard Operating Procedures
8. …. talent distribution curve
9. . .. consistent, reproducible, correct results
10. . . .. a few exceptionally able people

-- VOCABULARY

Match these words with their meanings in the context:

1. throughput (abstract)	a. to measure/ evaluate/ judge
2. sound (parag.45)	b. out of proper order
3. race (parag. 35)	c. a sharp-pointed tool for marking wood or metal to be cut
4. draft (parag. 34)	d. a canal for a current of water
5. shaft (parag. 26)	e. squeezed between two edges
6. flange (parag.33)	f. a projection used for strength or for attaching to another object
7. amiss (parag. 5)	g. a rotating support placed between moving parts to allow them to move easily
8. scribe (parag. 26)	h. free from defect or flaws
9. endorsed (parag. 12	i. output/production over period of time
10. bearing (parag.34)	j. a revolving rod in a machine that transmits motion or power
11. to gauge (parag. 13)	k. approved
12. pinched (parag. 35)	l. A device that regulates the flow or circulation of air.

-- LINKERS

What do the linkers in these sentences express? (reason, result, purpose, contrast, etc.)

1. Usually this happens because people involved in its installation, care and running do not know the right ways. (p. 7) ……
2. Though most operators and maintainers have some recognised training it can never be enough to competently handle all situations. (p. 8) ……
3. Provided it is corrected immediately and nothing bad happens, there was no harm done. (p. 10) ……
4. The ones you do get will cost you a lot of money because they are the elite in the industry. Hence standard operating procedures were created to use people from the around the middle and below ability levels to do higher standard work than they naturally could do unassisted. (p. 15) …… ……

5. Since standard operating procedures (SOPs) control the quality of the work performed by people not expert in a task, they are clearly absolutely critical to the proper running of a business. (p. 17) ……
6. Because people forget, those procedures on longer cycles than annually will need refreshment training before they are next done. (p.31) ……
7. You could say that vibration analysis was applied wonderfully well. But the truth is the repair procedure failed badly. (p. 36) ……
8. "Whereas" in paragraph 37. .....
9. Now read sentences 1, 2, 3, 4, 6, and 7 carefully and try to paraphrase them, i.e. keep the meaning and change the linker. You may need to make other changes as well.

III. **RECONSTRUCTION**

1. Write an outline of the article.
2. You are the Production Manager at a manufacturing firm. Make a presentation to explain to your workforce the new Accuracy Controlled Production and Maintenance policy that will be implemented in order to improve efficiency. Write a summary of the main points you will include.