

考試科目	科技管理文獻評析	所別	科管所	考試時間	5月16日 星期六	第1.2節
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請閱讀文獻，並回答下列問題：

一、 Innovation Lessons from the 1930s (20%)

1. 請問此篇文章中，作者（有關不景氣時，企業在研發創新方面的投資策略）主要的論點為何？您同意或不同意其論點？為什麼？
2. 本文的論點用 Patent Application 數目當 Proxy Variable，您同意或不同意？為什麼？

二、 Leadership and Innovation (35%)

1. 作者（有關 Leadership 與 Innovation 的關係）主要的論點為何？您是不是完全同意其論點？為什麼？
2. 您自己認為，創新的關鍵成功因素主要為何？請說明理由。
3. 作者為何談到 Innovation Networks？那方面與創新的關係可能為何？

三、 Medical Goes Digital (20%)

1. Medical 與 Digital Technology 的結合，在創新的相關學理上代表什麼樣的意義？
2. 您覺得這兩種領域的結合之創新過程中，相關廠商與人員會面臨到哪些挑戰？

四、 發展出研究 proposal (25%)

1. 請整合上述三篇文獻，發展出一個適當的研究架構(Research Framework)。並請扼要地加以說明。
2. 請接著說明後續的研究方法與可能的研究結果。

(背面還有試題)

考試科目	科技文獻評析	所別	科管所	考試時間	5月16日 星期六 第 1 節
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Innovation lessons from the 1930s

Recent turmoil in global financial markets and its spillover into the real economy have generated considerable interest in the Great Depression. There's much to be fascinated with, both in the parallels (banking failures, a large spike in real-estate foreclosures, and global uncertainty, for example) and the points of contrast (such as the speed and coordination of the response of central banks and finance ministries in 2008).

Can the business practices of the 1930s yield useful lessons for executives setting priorities in today's uncertain and evolving environment? For investments to promote innovation, the answer may be yes. Executives are often told to maintain investment during downturns. It's easy to question this countercyclical advice, however, in times like the Depression or the present, when the volatility of financial markets (an indicator of uncertainty) reaches historic highs. Is the typical behavior of executives—act cautiously and delay investment projects until confidence returns—the wiser course?

Many companies hesitated to innovate during the 1930s. Consider, for example, patent applications as a proxy for resources devoted to innovation. The growth rate of US patent applications by companies with R&D laboratories was considerably lower during the 1930s than in the preceding decade. On the whole, corporate executives considering plans for research investments preferred to wait and see.

Furthermore, patent applications were far more synchronized with the business cycle during the Depression, when the cycle was extremely volatile, than they had been during the '20s, when economic conditions were buoyant (exhibit). From 1929 to 1937, for example, there were five years of GDP growth and four years of GDP contraction. Patent applications generally followed the same pattern, lagging behind by one year: the number of patent applications increased during years following GDP growth and decreased during years following GDP contraction, with two exceptions: 1934 and 1935. As the economy whipsawed companies during the 1930s, they appear to have regularly adjusted their views about the payoff from innovation.

Yet several successful companies did not delay such investments. One was DuPont. In April 1930, a noted DuPont research scientist, Wallace Carothers, recorded the initial discovery of neoprene (synthetic rubber). Although the company's price levels and sales fell by roughly 10 and 15 percent, respectively, that year, DuPont boosted R&D spending to develop the new technology commercially. A buyer's market for research scientists and low raw-material prices helped the company to keep the cost of its research investments manageable. Neoprene, which DuPont publicly announced in November 1931 and introduced commercially in 1937, became one of the 20th century's major innovations. By 1939, every automobile and airplane manufactured in the United States had neoprene components. Similarly, DuPont discovered nylon in 1934 and introduced it in 1938 after intensive R&D and product development.

DuPont isn't the only such example. Many new technology companies—for instance, Hewlett-Packard and Polaroid—that became leading innovators later in the century were established as entrepreneurial start-ups during the 1930s. Radio Corporation of America, the high-tech company whose stock was bludgeoned during the Great Crash, returned to profitability in 1934 as it shifted its innovation efforts from radio to the nascent television market. In total, US companies founded at least 73 in-house R&D labs each year from 1929 to 1936.

考試科目	科管文南尤評析	所別	科會所	考試時間	5月16日 星期六	第1.2節
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Of course, these examples don't mean that aggressive investments for innovation would have been wise for every company during the 1930s or are universally wise today. But taken together, the patent research and the experience of successful innovators in those years suggest that although delay is the natural response to uncertainty, some companies should continue innovating even in an extraordinarily deep economic downturn—especially with technologies that take a long time to commercialize after discovery. Companies that delay these investments may forego significant growth opportunities when uncertainty subsides and the economy recovers.

The experience of the 1930s also illustrates a broader point. Although deep downturns are destructive, they can also have an upside. The Depression-era economist Joseph Schumpeter emphasized the positive consequences of downturns: the destruction of underperforming companies, the release of capital from dying sectors to new industries, and the movement of high-quality, skilled workers toward stronger employers. For companies with cash and ideas, history shows that downturns can provide enormous strategic opportunities.

二、Leadership and innovation

Source: Strategy Practice

Like short skirts, innovation has traditionally swung into and out of fashion: popular in good times and tossed back into the closet in downturns. But as globalization tears down the geographic boundaries and market barriers that once kept businesses from achieving their potential, a company's ability to innovate—to tap the fresh value-creating ideas of its employees and those of its partners, customers, suppliers, and other parties beyond its own boundaries—is anything but faddish. In fact, innovation has become a core driver of growth, performance, and valuation.

Our research bears out this point. More than 70 percent of the senior executives in a survey we recently conducted say that innovation will be at least one of the top three drivers of growth for their companies in the next three to five years.¹ Other executives see innovation as the most important way for companies to accelerate the pace of change in today's global business environment.² Leading strategic thinkers are moving beyond a focus on traditional product and service categories to pioneer innovations in business processes, distribution, value chains, business models, and even the functions of management

Our research also shows that most executives are generally disappointed in their ability to stimulate innovation: some 65 percent of the senior executives we surveyed were only "somewhat," "a little," or "not at all" confident about the decisions they make in this area.³ What explains the gap between the leaders' aspirations and execution? Even starting to build an organization in which innovation plays a central role is often far more frustrating than most executives ever imagine it to be. Many of those who mimic the approaches of the most successful practitioners have found that path to be ineffective. Sustaining innovation to create real value at scale—the only kind of innovation that has a significant financial impact—is even harder.

There are no best-practice solutions to seed and cultivate innovation. The structures and processes that many leaders reflexively use to encourage it are important, we find, but not sufficient. On the contrary, senior executives almost unanimously—94 percent—say that people and corporate culture are the most important drivers of innovation.

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考試科目	科管文獻評析	所別	科管所	考試時間	5月16日 星期六	第12節
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Our experience convinces us that a disciplined focus on three people-management fundamentals may produce the building blocks of an innovative organization. A first step is to formally integrate innovation into the strategic-management agenda of senior leaders to an extent that few companies have done so far. In this way, innovation can be not only encouraged but also managed, tracked, and measured as a core element in a company's growth aspirations. Second, executives can make better use of existing (and often untapped) talent for innovation, without implementing disruptive change programs, by creating the conditions that allow dynamic innovation networks to emerge and flourish. Finally, they can take explicit steps to foster an innovation culture based on trust among employees. In such a culture, people understand that their ideas are valued, trust that it is safe to express those ideas, and oversee risk collectively, together with their managers. Such an environment can be more effective than monetary incentives in sustaining innovation.

This list of steps is not exhaustive. Still, given the limited time and means—as well as the short-term performance pressures that executives constantly face—pursuing innovation with anything other than existing talent and resources often isn't an option. These three fundamentals are a practical starting point to improve an organization's chances of stimulating and sustaining innovation where it matters most—among a company's people.

Leading innovation

While senior executives cite innovation as an important driver of growth, few of them explicitly lead and manage it. About one-third say that they manage innovation on an ad hoc basis when necessary. Another third manage innovation as part of the senior-leadership team's agenda. How can something be a top priority if it isn't an integrated part of a company's core processes and of the leadership's strategic agenda and—above all—behavior?

According to 19 percent of the senior executives, neither growth nor innovation is part of the strategic-planning process, which focuses solely on budgeting and forecasting. Just under half indicated that innovation is integrated into the process informally. Only 27 percent said that innovation is fully integrated into it. But these executives feel more confident about their decisions on innovation and say that they have implemented ways to protect it and to ensure that it gets the right talent.

In a separate survey of 600 global business executives, managers, and professionals, the respondents pointed to leadership as the best predictor of innovation performance.⁴ Those who described their own organization as more innovative than other companies in its industry rated its leadership capabilities as “strong” or “very strong.”⁵ Conversely, those who believed that the ability of their own organization to innovate was below average rated its leadership capabilities as significantly lower and, in some cases, as poor.

As with any top-down initiative, the way leaders behave sends strong signals to employees. Innovation is inherently associated with change and takes attention and resources away from efforts to achieve short-term performance goals. More than initiatives for any other purpose, innovation may therefore require leaders to encourage employees in order to win over their hearts and minds. Our sample of 600 managers and professionals indicated that the top two motivators of behavior to promote innovation are strong leaders who encourage and protect it and top executives who spend their time actively managing and driving it. Indeed, senior executives believe that paying lip service to innovation but doing nothing about it is the most common way they inhibit it. The failure of executives to model innovation—encouraging behavior, such as risk taking and openness to new ideas, places second. Rewarding nothing but short-term performance and maintaining a fear of failure also make it to the top of the respondents' list of inhibitors.⁶

Holding leaders accountable for encouraging innovation makes a big difference. Thirty percent of the senior executives in the survey were accountable for it, through formal targets or metrics, in their performance reviews. They were more likely than the broader group of respondents to view innovation as one of the primary growth drivers, to manage it formally as part of the leadership team or through an innovation council, and to learn from their failures to achieve it.

考試科目	科管文獻評析	所別	科管所	考試時間	5月16日 星期六	第1.2節
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Our research implies that most senior executives do not actively encourage and model innovative behavior. If they did, they could give employees the support needed to innovate. They can also take a number of other practical steps to advance innovation.

1. **Define the kind of innovation that drives growth and helps meet strategic objectives.** When senior executives ask for substantial innovation in the gathering of consumer insights, the delivery of services, or the customer experience, for example, they communicate to employees the type of innovation they expect. In the absence of such direction, employees will come back with incremental and often familiar ideas.
2. **Add innovation to the formal agenda at regular leadership meetings.** We observe this approach among leading innovators. It sends an important signal to employees about the value management attaches to innovation.
3. **Set performance metrics and targets for innovation.** Leaders should think about two types of metrics: the financial (such as the percentage of total revenue from new products) and the behavioral. What metrics, for example, would have the greatest effect on how people work? One company required that 20 percent of its revenue come from products launched within the past three years. Another established targets for potential revenues from new ideas in order to ensure that they would be substantial enough to affect its performance. Leaders can also set metrics to change ingrained behavior, such as the "not invented here" syndrome, by requiring 25 percent of all ideas to come from external sources.

Senior executives say that the top three ways they spend time making decisions about innovation involve determining what types or strategies to focus on, who gets to work on the resulting projects, and how to commercialize the fruits. Few spend time on targets, metrics, and budgets for innovation. That is telling, since executives whose companies do have such targets and metrics feel the greatest confidence in their decisions.

Designing innovation networks

Chances are your organization has some people who are passionate about innovation and others who feel uncomfortable about any topic related to change. Recent academic research finds that differences in individual creativity and intelligence matter far less for innovation than connections and networks—for example, networked employees can realize their innovations and make them catch on more quickly.⁷

Since new ideas seem to spur more new ideas, networks generate a cycle of innovation. Furthermore, effective networks allow people with different kinds of knowledge and ways of tackling problems to cross-fertilize ideas. By focusing on getting the most from innovation networks, leaders can therefore capture more value from existing resources, without launching a large-scale change-management program.

Social-network analysis can help executives to diagnose existing networks in order to ascertain their characteristics, such as the frequency of collaboration and the degree of cross-functional interactions among members, and to identify people who broker information and knowledge. This kind of information can also serve an essential role in the creation of effective innovation networks by clarifying the mind-sets of individuals and groups.

In one company, for example, we found three groups with distinct perspectives on innovation. One believed that the company was innovative, but the other two, with 57 percent of its employees, thought that it wasn't—indeed, that it was actually bureaucratic, slow moving, inefficient, and stressful. A separately developed network map highlighted the company's hierarchical structure but also showed that cross-functional departments were well connected.

When we combined the analysis of personal perspectives on innovation with the network map, we found opportunities for improvement. Paradoxically, the analysis revealed that those employees, largely middle managers, with the most negative attitude toward innovation were also the most highly sought after for advice about it. In effect, they served as bottlenecks to the flow of new ideas and the open sharing of knowledge. A further analysis of the people in this group highlighted their inability to balance new ideas with current priorities and to behave as leaders rather than supervisors. We have observed that middle managers pose similar challenges in many organizations.

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考試科目	科管文獻評析	所別	科管所	考試時間	5月16日 星期六	第1.2節
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Senior management used this analysis to create a network of middle managers who were encouraged to generate newer and bigger ideas. Members of the network regularly discussed new ideas with senior executives, and these ideas were evaluated collectively by mutually agreed-upon criteria.

Shaping innovation networks is both an art and a science. Any network is unpredictable and, in the end, impossible to control. Focusing on the replacement of one or two ineffective members has less impact than establishing the conditions for vibrant networks and taking advantage of the connections through which they flourish.

Making networks more decentralized is another way to improve collaboration and performance (Exhibit 1). Consider the case of two geographically separate units that undertake the same activities. A larger leadership group with an open and positive mind-set is a distinguishing feature of the higher-performing unit. Its information network is also more decentralized, with a larger number of connections. Hierarchy is still evident in the higher-performing unit, but its information and knowledge network is more distributed, and more of the members participate actively. The lower-performing unit has just one leader, who controls most of the interactions and has a negative mind-set about openness and collaboration, and there are far fewer connections. The network design is more centralized.

The four critical steps in designing, implementing, and managing an innovation network are presented in Exhibit 2. In addition, executives can fine-tune the network's goals by identifying the appropriate mix and balance of employees. Innovation networks, like cross-functional teams, require different skills and attitudes. In our experience, they include combinations of several archetypes:

- Idea generators prefer to come up with ideas, believe that asking the right questions is more important than having the right answers, and are willing to take risks on high-profile experiments.
- Researchers mine data to find patterns, which they use as a source of new ideas. They are the most likely members of the network to seek consumer insights and to regard such insights as a primary input.
- Experts value proficiency in a single domain and relish opportunities to get things done.
- Producers orchestrate the activities of the network. Others come to them for new ideas or to get things done. Producers are also the most likely members of the network to be making connections across teams and groups.

This kind of staffing is clearly an inexact science. A team or network in need of more ideas might get additional idea generators to fill the gap. If the challenge is commercializing the right ideas, management might opt to add producers and experts. In our survey of professionals, respondents who regarded their companies as more innovative than competitors in the same industry were also more likely to work for companies that had larger numbers of producers.

Cultures of trust

Senior executives say that making top talent available for projects to meet innovation goals is their single biggest challenge in this area. Some 40 percent of them also believe that they do not have enough of the right kinds of talent for the innovation projects they pursue. A different view emerges from below, however. Employees are more likely to believe that their organizations have the right talent but that the corporate culture inhibits them from innovating (Exhibit 3). We, for our part, believe that defining and creating the right kind of culture, however elusive, greatly increases the prospects for successful and sustained innovation

Managers and employees broadly agree about the attitudes, values, and behavior that promote innovation. Topping the list, in our research, were openness to new ideas and a willingness to experiment and take risks. In an innovative culture, employees know that their ideas are valued and believe that it is safe to express and act on those ideas and to learn from failure. Leaders reinforce this state of mind by involving employees in decisions that matter to them. Respondents to our survey of 600 executives and managers indicated that trust and engagement were the mind-sets most closely correlated with a strong performance on innovation. In the same survey, 46 percent of the professionals surveyed said that they were far more likely to seek out a trusted colleague than an expert or manager to get new ideas and feedback on their own ideas.

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考試科目	科管文獻分析	所別	科管所	考試時間	5月16日 星期六	第1,2節
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There is also widespread agreement about the cultural attributes that inhibit innovation: a bureaucratic, hierarchical, and fearful environment. Such cultures often starve innovation of resources and use incentives intended to promote short-term performance and an intolerance of failure. Only 28 percent of the senior executives in the survey said that they are more likely to focus on the risks of innovation than on the opportunities, but only 38 percent said that they actively learn from innovation failures and encourage the organization to do so as well. Even more alarmingly, only 23 percent of the employees believe that their organizations encourage them to learn from failure. To make a corporate culture friendlier to innovation, managers must acquire new skills to engage and lead the staff. Many fall under the heading of leadership skills, such as coaching (as opposed to ordering) subordinates and facilitating collaboration across silos.

Corporate-wide change programs not only are daunting and time consuming but also often have only a limited impact. Our experience helping companies to change and become more innovative suggests that they can make progress without such programs. We have described a number of leadership role-modeling and formal organizational mechanisms to promote innovation. When top management reinforces them with commitment and energy to build capabilities for specific tasks, the combination can yield impressive results. Top teams can help build a more innovative culture in several ways:

1. **Embrace innovation as a top team.** It's not enough for the CEO to make innovation a personal goal and to attend meetings on innovation regularly. Members of the top team must agree that promoting it is a core part of the company's strategy, reflect on the way their own behavior reinforces or inhibits it, and decide how they should role-model the change and engage middle management.
2. **Turn selected managers into innovation leaders.** Identify managers who already act, to some degree, as network brokers and improve their coaching and facilitation skills so that they can build the capabilities of other people involved in innovation efforts more effectively. The goal: making networks more productive.
3. **Create opportunities for managed experimentation and quick success.** Not surprisingly, this approach is typically the best way to start any change effort in large organizations. Quick success matters even more with innovation: people need to see results and to participate in the change. To get going quickly and learn along the way, select an innovation theme or topic area and then create small project teams. While you try out topics and ideas, test the most effective leadership and organizational approaches for your organization. The goal isn't to get it right the first time but to move quickly to give as many influential employees as possible a positive experience of innovation, even if a project doesn't generate profits immediately. A positive experience will make all the difference in building the organization's capabilities and confidence.

Innovation is a big idea with a big potential. But it is wise to approach it in small steps, implementing just one or a few of the ideas we propose and building from there. For many companies, the initial steps on this value-creating journey are the most critical of all.

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考試科目	科管文獻評析	所別	科管所	考試時間	5月16日 星期六 第1,2節
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三. Medicine goes digital

Health 2.0

The arrival of digital medicine is already empowering patients—but will it also lead to better health? Page 15

The convergence of biology and engineering is turning health care into an information industry. That will be disruptive, says Vijay Vaitheeswaran, but also hugely beneficial to patients

INNOVATION and medicine go together. The ancient Egyptians are thought to have performed surgery back in 2750BC, and the Romans developed medical tools such as forceps and surgical needles. In modern times medicine has been transformed by waves of discovery that have brought marvels like antibiotics, vaccines and heart stents.

ing such long-heralded ideas as telemedicine, personal medical devices for the home and smart pills.

The first technological revolution in modern biology started when James Watson and Francis Crick described the structure of DNA half a century ago. That established the fields of molecular and cell biology, the basis of the biotechnology industry. The sequencing of the human genome nearly a decade ago set off a second revolution which has started to illuminate the origins of diseases.

The great convergence

Now the industry is convinced that a third revolution is under way: the convergence of biology and engineering. A recent report from the Massachusetts Institute of Technology (MIT) says that physical sciences have already been transformed by their adoption of information technology, advanced materials, imaging, nanotechnology and sophisticated modelling and simulation. Phillip Sharp, a Nobel prize-winner at that university, believes that those tools are about to be brought to bear on biology too. ▶▶

Given its history of innovation, the health-care sector has been surprisingly reluctant to embrace information technology (IT). Whereas every other big industry has computerised with gusto since the 1980s, doctors in most parts of the world still work mainly with pen and paper.

But now, in fits and starts, medicine is at long last catching up. As this special report will explain, it is likely to be transformed by the introduction of electronic health records that can be turned into searchable medical databases, providing a "smart grid" for medicine that will not only improve clinical practice but also help to revive drugs research. Developing countries are already using mobile phones to put a doctor into patients' pockets. Devices and diagnostics are also going digital, advanc-

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A list of sources is at

Economist.com/specialreports

An audio interview with the author is at

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More articles about health are at

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考試科目	科管文獻評析	所別	科管所	考試時間	5月16日 星期六	第 1 之 節
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▶ Robert Langer, a biochemist at MIT who holds over 500 patents in biotechnology and medical technologies and has started or advised more than 100 new companies, thinks innovation in medical technologies is about to take off. Menno Prins of Philips, a Dutch multinational with a big medical-technology division, explains that, "like chemistry before it, biology is moving from a world of alchemy and ignorance to becoming a predictable, repeatable science." Ajay Royyuru of IBM, an IT giant, argues that "it's the transformation of biology into an information science from a discovery science."

This special report will ask how much of this grand vision is likely to become reality. Some of the industry's optimism appears to be well-founded. As the rich world gets older and sicker and the poor world gets wealthier and fatter, the market for medical innovations of all kinds is bound to grow. Clever technology can help solve two big problems in health care: overspending in the rich world and under-

provisioning in the poor world.

But the chances are that this will take time, and turn out to be more of a reformation than a revolution. The hidebound health-care systems of the rich world may resist new technologies even as poor countries leapfrog ahead. There is already a backlash against genomics, which has been oversold to consumers as a deterministic science. And given soaring health-care costs, insurers and health systems may not want to adopt new technologies unless inventors can show conclusively that they will produce better outcomes and offer value for money.

If these obstacles can be overcome, then the biggest winner will be the patient. In the past medicine has taken a paternalistic stance, with the all-knowing physician dispensing wisdom from on high, but that is becoming increasingly untenable. Digitisation promises to connect doctors not only to everything they need to know about their patients but also to other doctors who have treated similar disorders.

The coming convergence of biology and engineering will be led by information technologies, which in medicine means the digitisation of medical records and the establishment of an intelligent network for sharing those records. That essential reform will enable many other big technological changes to be introduced.

Just as important, it can make that information available to the patients too, empowering them to play a bigger part in managing their own health affairs. This is controversial, and with good reason. Many doctors, and some patients, reckon they lack the knowledge to make informed decisions. But patients actually know a great deal about many diseases, especially chronic ones like diabetes and heart problems with which they often live for many years. The best way to deal with those is for individuals to take more responsibility for their own health and prevent problems before they require costly hospital visits. That means putting electronic health records directly into patients' hands. ■

考試科目	產業經濟學	所別	科管所	考試時間	5月16日 星期六	第3節
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- 一、 (20%) 將你要脫手的一件古董拿到 YAHOO 電子市集上去拍賣所得的價格一定會比你去尋訪古董商所得的價格高嗎？為什麼？為什麼不？有哪些因素在影響？
- 二、 (30%) 請以 Google 公司的成功經驗來解釋以下名詞：
(1) 網路外部性，(2) 套牢，(3) 規模經濟，
(4) 規模報酬遞增，(5) 市場失靈
- 三、 (20%) 請自行設定賽局報酬矩陣，以
(1) 說明「囚犯困局」的現象。
(2) 說明「為何人人都不喜歡污染，但卻還是有人會丟垃圾？」
(3) 說明「為何科技創新對整個社會有好處，但人們進行創新的意願卻不足？」
(4) 「囚犯困局」和「外部性」有何關係？
- 四、 (10%) 等產量曲線上經濟效率(Allocative Efficiency)最佳的投入組合如何決定？當「技術進步」時，等產量曲線會有何變化？
- 五、 (20%) 政府一定要介入科技發展嗎？請用經濟學的推理方式來分析。