

一、請嚴厲批判以下五篇文章(各佔15%，共75%)，並說明你支持或不支持其中那些論點，理由為何？

1. 愛因斯坦說的有理嗎？
2. The Innovative organization
3. 資訊革命了什麼？後記
4. 知識的戰爭，最珍貴的資產
5. A roadmap for Natural Capitalism

二、請用這五篇文章的主要概念形成一個「研究計劃」(25%)，包括：

- (1) 寫出五個相關的「研究問題」。
- (2) 草擬一個「研究架構」能涵蓋這些研究問題。
- (3) 說明主要的研究概念、研究變數(項)(說明其操作性定義)、研究对象。
- (4) 說明你的研究設計所造成的「研究限制」。
- (5) 說明此一研究可能的「研究貢獻」，對那些理論會有增益、及在實踐上的意義。

新不新很重要

認為「嶄新不重要」的人辯稱，一個理論好不好，應從它本身的價值來評判，而不管它是怎麼被發現的。假設有某個理論稱為甲理論，與乙、丙、丁事實相符，現在就來評斷它的優劣。為什麼研究人員在發明甲理論之前，應先知道乙、丙、丁事實已存在？為什麼研究人員的精神狀態比頭髮是怎麼梳的還重要？

我們來打個簡單的比方。假設在你左邊抽屜裡的襪子有一半是黑色的，右邊抽屜裡的襪子全部沒有黑色。從左邊抽屜選一只襪子，選到黑色襪子的機率有多大？當然是一半。現在再假設你蒙起眼睛，到某一隨意選定的抽屜，拿一只襪子出來。你太太在一旁觀看，告訴你選到的是左邊的抽屜。這麼一來，選到的襪子是黑色的機率有多大？還是一半。決定機率多寡的是襪子從哪裡選出來的，而不是你在拿襪子時知道了些什麼。

科學家在各種理論間作選擇時，情況便很像上述選襪子的比方，在他左邊抽屜裡擺的是與一組事實吻合的理論，其中一半的理論是正確的。右邊的抽屜裡則是一堆與事實不合的理論，沒有一個理論是正確的。史密斯教授一開始的時候知道所有的事實，然後建構了一個理論，與所有的事實吻合；史密斯教授很小心地從左邊的抽屜裡選了一個理

論，這個理論正確的機率是一半。鍾斯教授則是在瞭解事實之前建構理論，做了一個嶄新的假設，也就是蒙著眼睛隨便找了個抽屜。知道他的理論與事實吻合之後，鍾斯教授發現他選到的是左邊的抽屜，他的理論正確的機率是一半，正好跟史密斯教授一樣。

當然了，襪子和理論是非常不同的兩樣東西，但是兩者都適用於同樣的基本機率法則，如果選擇科學理論的方式和選襪子沒有太大的不同，這個說法就很可靠，並證明嶄新與否並不重要。

認為嶄新並不重要的論點，看起來似乎很簡單，一目瞭然，但現代許多科學家仍對其抱持相當大的懷疑態度。他們辯稱，任何人都能夠拿現有的事實，構思出某種理論來「解釋」它們，所以嶄新的預測才是科學成就的正字標記。他們有強烈的直覺，相信嶄新確實很重要，知性面的挑戰則是去解釋為何如此。

如果嶄新真的很重要，那一定是因為建構科學理論時，跟蒙著眼睛選襪子在某些方面有所不同。當然了，隨便找個人都能列出兩者間一些明顯的不同點——一種是在實驗室裡進行，另一種是在臥室裡進行；一種有政府的補助，另一種則沒有。但要找出關鍵性的不同點，顯示嶄新確實很重要，則十分困難。

近數十年來，有關嶄新一事的探討，幾乎完全限制在哲學刊物裡面。但最明顯的相關問題是：在資訊不完整的情況下，我們應如何去做推理？關於這個問題，經濟學家略

懂一二。

哪個科學家比較有才華？

即使是在最簡單的狀況中，嶄新的預測還是有它的用處，因為它可作為揭露資訊的一種方法。假設某些科學家天生比別人有才華，但我們事前無法得知是哪些科學家，不過我們知道才氣縱橫的科學家較有可能建構出真正的理論，同時也較有可能成功地做出嶄新的預測。鍾斯教授做一個嶄新的預測時，披露了自身某些才華，至少就機率面來說是如此。成功的嶄新預測者較有可能是才華洋溢的科學家，因此較有可能提出真正的理論。所以我們認為鍾斯的理論比史密斯的理論更有價值，不是因為嶄新的預測所發揮的直接影響力，而是因為嶄新的預測成功之後，告訴我們有關鍾斯教授這個人的某些特質。

我們的故事距離完整還有一大段路。我們還沒有談到，為什麼鍾斯教授想到要去做嶄新的預測，而史密斯教授卻沒有。鍾斯教授是不是揭露了一些事情，讓我們知道他對自己的能力相當有信心？而史密斯教授卻讓人感到他對自己的能力不太有把握？果真如此，那我們又多了一層理由，對鍾斯教授懷有的信心可以甚於對史密斯教授的信心。換

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句話說，我們大可合情合理地根據鍾斯教授成功的斬新預測去推理，也可以從他一開始就願意冒險去做斬新的預測，推斷他的理論是正確的。

舉個具體的例子來說，假設經常成功地做出斬新預測的科學家，每年有十萬美元的收入，而沒有成功地做出斬新預測的科學家每年賺二萬美元，從未試著去做斬新預測的科學家每年賺五萬美元。斬新的預測者使自己的所得處於危險之中，由於他願意拿自己的才華下賭注，其他人也很有可能相信他，跟著他一起下注；另外，對於那些選擇拿五萬美元就走的科學家，令人不禁想問：我們對他的信心會比他對自己的信心還高嗎？

我們能做出什麼樣的推理，全看鍾斯和史密斯會對什麼樣的誘因有所反應。現在我們真的是身處經濟學家的領域中。我們需要一個理論，去預測利用不同的激勵結構，個別科學家會產生什麼樣的反應，旁觀者可以從這些反應做出什麼樣的推論。

一個令人完全滿意的激勵理論，會考慮到科學家間的競爭、研究機構間的競爭、科學研究贊助者和受益人間的競爭，各種利益間的衝突而形成一種薪資結構，針對不同的研究策略和不同程度的成功，給予各式各樣的獎勵。很遺憾的，要瞭解這種理論的涵義十分困難。

所以我們退回到比較簡單的問題。假設有位國寶級的科學大師受命設計一套制度，用來激勵科學家提高研究效率。我們可以預期，他所構思的制度，和在競爭情況下出現

的制度不會有太大的不同。畢竟，我們從經濟學中其他許多例子，知道競爭可以產生高效率的結果。現在，我們來想想這位科學大師應該做些什麼事，希望從我們的思考中，找出和實際世界中觀察到的事情相近的東西。即使這些期望落空，我們的努力也不會白白浪費掉，可留下一些寶貴的經驗，向未來的科學大師提出諍言。

科學大師的難題

這位科學大師可以命令科學家「先觀察」或者「先架構理論」。前者是在提出理論之前，先探討所有的資料；後者則是一開始就試著去做斬新的預測，如果預測錯誤，才把理論丟掉。

先提出理論是種十分浪費的行為，因為科學家投入很多心力架構的理論，至少有一部分最後可能被事實所推翻。一開始就蒐集資料的話，科學家就能避開這種錯誤，而有更多的時間去提出好的理論，因此，科學大師可能命令每個人都先觀察。但是先觀察也有其缺點，可能會建構出許多（彼此間可能相互衝突的）理論，卻沒辦法區辨何者最有希望成功。假使科學大師想建一座橋，那麼會有一大堆相互矛盾的建橋理論提到他面前，最後不曉得選哪種理論好。

假使科學家先建構理論，許多理論最後會被實際的證據所推翻，存活下來的理論通過了考驗，顯示提出這些理論的人比一般人還聰明。因此，大師對這些理論格外有信心，用這些理論建構時，他深信橋不會垮掉。

但兩者各有利弊得失。假使科學家先建構理論，則所做的研究代價十分昂貴，存活下來的理論太少，蓋出的好橋數量不夠多；假使科學家先觀察事實資料，則沒辦法從那麼多的理論中區辨何者為佳，何者為劣，結果蓋出來的壞橋太多，最後一一垮掉。

賢明的大師可能在兩者間取中庸之道，一方面避免先提出理論發生的浪費，另一方面則避免先觀察事實資料所發生的另一種浪費。最好的作法可能是指定某些科學家先研究理論，指定其他一些科學家先觀察事實，但是有什麼合理的基礎可用來決定哪些科學家應歸入先做理論的一羣，另些科學家則應歸入先觀察事實的一羣？

假使科學家對我們目前所要研究的計畫，知道自己的能力程度，同時知道自己對這個計畫有沒有興趣，那麼答案可能呼之欲出。在提出好的理論方面，有些科學家比別人更有自信，而這種自信是來自其有很好的依據，至少有些時候是如此。

為了儘可能簡化，假設科學家有「好」、「壞」之分，「好」的定義只是「比別人更有可能提出真正的理論」，「壞」的定義則正好相反。我們也假設（同樣只是為了簡化）所有的科學家知道自己的類型。（有些科學家確實瞭解自己的類型，所以這個假設

接近實際的狀況。）

在這些情況下，大師的主要目標之一是區分好的科學家和壞的科學家，這個資訊對他來說很珍貴，有下列二種截然不同的理由：

- 一、如果他能找到好的科學家，那麼在蓋橋的時候，他會知道要用誰的理論。
- 二、如果他能找到好的科學家，就能給他們高於壞科學家的待遇。這種作法可以鼓勵比較有才華的人一開始就立志成為科學家，同時驅使那些才華在別處的人往其他方面發展。

大師怎麼決定誰是好的科學家，誰是壞的科學家？

最簡單的方法是開口去問。很遺憾的，由於他準備給好科學家的待遇優於壞科學家，所以沒把握每個人都誠實地回答這個直截了當的問題。相反的，他必須找出方法，給說真話的人獎勵。

依我前面所說，我們是可以找到解決方法。大師可以設立兩個不同的研究機構，分別是先觀察事實資料的機構和先建構理論的機構。在先觀察事實資料的研究機構裡，所有科學家一律先觀察事實，每個人一年都拿五萬美元的待遇；在先建構理論的研究機構裡，所有的科學家一律先提出理論，理論獲得證實正確者，每年拿十萬美元的待遇，理論遭駁回者每年拿二萬美元。

如果這些薪資設定得十分適當，那麼好的科學家，也就是自信能成功地做出嶄新預測者，將會願意在先建構理論的研究機構做事，因其有把握可以拿到很高的待遇。壞的科學家因為知道自己嶄新的預測往往失敗，所以願意在先觀察事實資料的研究機構裡做事，每年保證可拿到五萬美元的待遇。這個解決方法有個很妙的地方，那就是科學家會自動透露對大師有用的資訊，即使剛開始不想這麼做，最後還是會這麼做。

當然了，有些科學家運氣不佳，最後一年只能拿到二萬美元。但是好的科學家平均來說賺得比壞的科學家多，而且其中相當多的人會被吸引，選擇科學研究做終身事業，當大師要蓋橋時，便知道要找誰提供意見。在先觀察事實資料機構裡做事的科學家所做的貢獻，會得到很有禮貌的認可，但永遠不會被採納而採取行動。

這個辦法是有一些很好的特質，卻也有部分不好的地方。首先，好的科學家會浪費時間和不少精力在先建構理論上。假使他們能先觀察，就可以避免一些盲目摸索造成的浪費。很遺憾的，先觀察事實資料會使他們事業生涯的風險降低，這麼一來，壞的科學家會開始滲透到他們的行列中。只有理論被駁拒的可能性，才會嚇跑壞的科學家脫離先建構理論的機構。大師強迫好的科學家浪費時間和精力，能夠誘使壞的科學家顯露出自己真實的一面，因此得到的資訊，大可彌補所浪費掉的時間和精力。

另一個很奇怪的特色是，壞的科學家縱然事先已知自己所提的理論毫無社會價值，

每年還是能夠拿到五萬美元。這件事也是必要的，因為這樣才能阻止壞的科學家滲透到聲望崇隆的先建構理論的機構裡。除非壞的科學家受到的待遇相當安適，否則他們會開始冒充好的科學家，給大師造成很大的困擾。

把科學研究留給民間部門去做不會有好處，因為民間企業不會僱用提出毫無用處理論的壞科學家。但為避免壞的科學家冒充是好的科學家，就整個社會來說，這種民間公司很重要。所以我們的理論指出，政府必須在科學研究活動的組織整合上扮演十分重要的角色，因為只有政府願意花錢資助那些毫無社會價值的研究。

這個模式合乎實際嗎？它當然具備真實科學研究世界中的許多特質。在真實的世界中，有所謂的「高能」研究機構和「低能」研究機構，前者的薪資多寡必須取決於研究成果，後者則是每個人幾乎被一視同仁對待。科學家主要是依據自己對個人能力的期望，而選擇要進入哪種機構做事。這個理論另有涵義，那就是許多壞科學家因為製造了完全無用的研究，而得到相當好的待遇，加上這個世界上的壞科學家人數可能比仁慈的大師所希望的還多；對那些熟悉現代科學結構的人來說，這些涵義頗有道理。

區分好科學家和壞科學家的模式，不是讓嶄新的預測行得通的唯一論點，但是我懷疑，曾被人這麼詳細說明的論點只有這一個。最好還有其他理論也同樣詳細闡明，好讓我們可以認真地考慮它們的價值。

二, **The innovative organization: Why new ventures need more than a room of their own.**



The innovative organization

Companies *can* grow quickly without sacrificing performance discipline. The trick is to balance partitioning and integration.

JONATHAN D. DAY, PAUL Y. MANG, ANSGAR RICHTER, AND JOHN ROBERTS

The idea that new businesses prosper best when separated from their corporate parents has become a commonplace. Separation is no doubt the model of choice when the new and the old differ greatly—for example, an Internet start-up launched by an industrial company. But the simple injunction to cordon off new businesses is too narrow. Although ventures do need space to develop, strict separation can prevent them from obtaining invaluable resources and rob their parents of the vitality they can generate. Two-way relationships are needed, though only a few companies have developed organizations in which such relationships thrive.

Yet a delicate blend of separation and cooperation is a prerequisite for satisfying the twin demands of today's investors: focused performance and faster growth. The 1980s were mostly concerned with performance.¹ Underperforming assets were to be fixed—or sold. Diversification was viewed at best with suspicion and, when it took companies outside their areas of "core competence," regarded as a managerial crime.² Accordingly, the decade witnessed a wave of "bust-up" takeovers as acquirers split conglomerates into focused components and sold them to buyers in related industries.

The past few years have told a different story. Investors still expect top performance from a company's core business and high returns on existing assets. But they also demand growth: new assets and entry into new business arenas. Mergers increasingly aim to generate horizontal synergies, creating corporate behemoths of unprecedented size and strategic diversity.

Although investors still expect top performance and high returns from a company's core business units, they now also demand growth

How can companies deliver this combination of focus and flexibility, performance and growth? The conventional advice has been to plant the seeds of "foreign" businesses, acquired or developed internally, in walled gardens so that established businesses can't trample them. Citing the experiences of companies that have failed to take advantage of opportunities to innovate, a number of authors³ have argued that greenfield units should be kept far away from operating businesses, even to the extent of physically separating their headquarters.

We believe that partitioning is desirable but can easily go too far. A company that seeks both performance and growth should give entrepreneurial activities plenty of space but also connect them, from the outset, to its parent's resources, knowledge, and goals. Achieving this balance of separation and integration calls for the full range of organizational and leadership interventions: structure as well as management processes, human-resources policies, and corporate culture.

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SEPARATE AND INTEGRATE

Planning and resource allocation processes designed for established businesses can wither the prospects of a new one. Established businesses have customers, organizational structures, and prejudices that dispose them to stick with the familiar when they decide where to make their investments. Spending on core businesses, where risks are relatively easy to identify and control, can be defended without great difficulty. Investments in the discontinuous innovations that transform industries but pose greater risks are harder to justify, and the business case for these investments is harder to make without ambiguity.⁴

In the fight for corporate capital, talent, and commitment, new ideas often fail to attract managerial attention, particularly in their early stages: compared with an existing business, an idea of unproven worth can seem insubstantial. But by planting new ideas in separate organizational structures, managers can change the scale of comparison and create roles focused on nurturing new ideas rather than minimizing or squelching them.

Of course, leaders of existing businesses know that new initiatives may eventually replace them. Adding insult to injury, cash from core operations finances the challenges. Managers may thus resort to destructive tactics such as acquiring illiquid assets to make their units harder to sell or distorting news about the newcomers' success. For this reason, too, it often makes sense to place new and old businesses in separate entities and to limit the interaction between them, not only to shelter new businesses, but also to let the managers of core ones concentrate on meeting performance targets. Each kind of enterprise can operate under its own resource allocation criteria, performance measurement systems, and reward structures.

One way of increasing the distance between legacy businesses and new opportunities is to spin off or carve out distinct, legally separate units, as American Airlines did with Sabre (a reservations and information system) and Siemens with Infineon (a semiconductor manufacturer).⁵ By contrast, Donaldson, Lufkin & Jenrette kept its e-brokerage subsidiary, DLJdirect, in-house but gave the unit separate responsibilities and authority within a rigorously decentralized structure.⁶ Two-thirds of all established companies setting up Internet-based operations are said to have followed this model.

Although partitioning on either model can take a company a long way toward achieving the goals of growth and performance, it presents a number of problems, primarily because it pushes the recognition and selection tasks involved in innovation and business building up to higher levels of management. In strictly partitioned organizations, very senior executives are responsible for detecting new possibilities and patterns and for bringing new ideas into focus. The chief executive must recognize embryonic ideas wherever they appear, combine them with other ideas and resources, and give them an appropriate organizational form—all without special allegiance to either the old or the new businesses.

Top managers, already struggling to maintain contact with existing customers, markets, and employees, are faced with a growing information overload. In some cases, new ideas are suppressed too quickly; in others, top managers champion projects whose true potential hasn't been assessed accurately. Many observers have attributed Apple Computer's wasteful investment in the failed Newton personal digital assistant to then-CEO John Sculley's early and enthusiastic promotion of the project. Moreover, since partitioning creates new organizational boundaries, it also limits the flow of information and ideas and thereby makes it more likely that they might be lost. Growth opportunities identified in the course of operating a core business can be a rich source of incremental and transforming innovations. Sony's Walkman and Corning's fiber-optic businesses emerged in just this way. In contrast, new businesses segregated from legacy businesses usually lack close contact with key customers, technology providers, and competitors—contacts that often generate promising new opportunities.

Top managers, already struggling with existing customers, markets, and employees, are faced with a growing information overload

Isolated new businesses also have difficulty rejoining the mainstream, especially when they have developed new business models that are supposed to reinvigorate the operations they had left behind. Meanwhile, mature operating units, sealed off from the organization's pockets of innovation, can acquire self-fulfilling labels such as "low growth" or "old economy," particularly when the new units are Internet related. The harder management tries to keep the old apart from the new, the more vociferously will employees of the core business complain that they are being denied their fair share of the new unit's success or fame; few people want to be stuck in a low-growth business when more glamorous opportunities exist under the same corporate roof.

STRIKING A BALANCE: NOKIA

Separation and integration both serve the cause of profitable growth, so companies should drive both simultaneously. Consider the case of Nokia,² the Finnish telecommunications giant. The company is interesting not only because it has apparently succeeded in achieving the seemingly incompatible objectives of performance and growth but also because it uses a wide variety of organizational mechanisms to do so.

Nokia has two major business groups: Nokia Mobile Phones (NMP), the world's largest producer, and Nokia Networks (Net), a leading producer of mobile and fixed-line network equipment. The Nokia Research Center undertakes basic research for the business groups.

NEW VENTURES

In 1998, Nokia established the Nokia Ventures Organization (NVO) to test and develop nascent ideas that had the potential to generate revenues of \$500 million to \$1 billion within four to five years. Pekka Ala-Pietilä, the president of Nokia and of NVO, explains that the company "needed this kind of unit at the corporate level" because some initiatives "didn't fall easily into Nokia's existing organizational structure; they fell somehow in between the existing units, or they took place across these entities. So nobody was the natural owner of these initiatives. Therefore, the purpose of NVO is to look at growth opportunities that are *beyond* the remit of the existing businesses but *within* Nokia's overall vision."

At first glance, Nokia's organizational chart tells a partitioning story: truly innovative activities have apparently been separated from the operating business units and moved to NVO. However, a closer look reveals a range of mechanisms that closely link the two (exhibit).

Although NVO includes a venture capital fund that has been chartered to look for ideas originating outside Nokia, NVO's primary purpose is to develop internally generated projects. Some 80 percent of the 17,000 Nokia employees who have innovation-related jobs work for NMP or for Net. Every Nokia unit is expected to search for new ideas, and most new ideas are actually developed within the business groups. NVO deals only with proposals that go beyond Nokia's current technologies and seem likely to create new markets. The internal venture capital fund works in the same way; investments and acquisitions within the scope of the company's current strategy are made by the business groups, not by NVO.

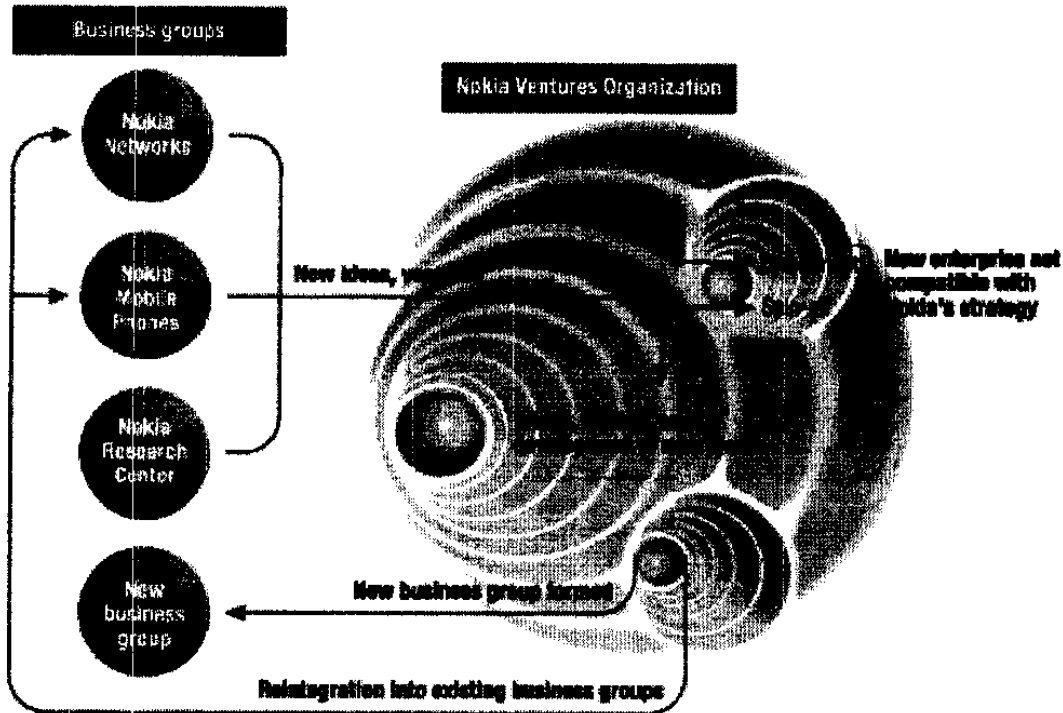
Nascent ideas or young businesses moved into NVO don't stay there indefinitely: the viable ones are eventually integrated into the operating businesses, established as new divisions, or sold. As Markus Lindqvist, NVO's director of business development, says, "NVO does not exist for itself; it exists for Nokia, and that means, in particular, that if we start to do things, we don't regard them as being our own. What we do is up [to] somebody else to take further. Our customer is Nokia." In short, NVO functions as an accelerator: it speeds up the development of ideas. Businesses that can run on their own leave NVO.

Over the past 15 years, Nokia has exited from many businesses that didn't fit into its overall plans, and it exercises the same discipline in reviewing ideas being explored in NVO. One of NVO's undertakings, a health-services unit that developed telecom-based technologies for treating diabetes and other illnesses, was moved from its original home in NMP into NVO in 1998 and then sold a year later because Nokia felt that new owners could add more value.

Decisions about moving businesses between NVO and the business groups are made jointly by managers on both sides. New ideas emerging from day-to-day operations are normally passed on to the business groups and their development managers, who decide which unit has the best position for advancing these projects. If they look particularly promising, they go to the Nokia Ventures Board, which involves people from NVO, the Nokia Research Center, and the mainline businesses. The board decides how to combine ideas from a variety of sources, whether to embody those ideas as new businesses, and where such businesses should fit into the corporate organization. All ventures, whether they are developed in NVO or stay in the business groups, go through the same process.

EXHIBIT

Nokia keeps ideas mobile



國立政治大學圖書館

INCENTIVES

To ensure that people don't get overly attached to pet projects, NVO and the business groups also have the same financial incentives and salary schemes. Performance-related bonuses tend to reward the achievements of teams and of the whole company, not of individuals, and contingent pay forms a relatively small part of overall remuneration. The intention is to encourage Nokia managers, from the start, to concern themselves with the good of the company as a whole.

In the conventional view, managers who have no strong financial incentives won't take risks or make the extra effort needed to develop and promote emerging businesses. Yet these things happen at Nokia. Although some features of its incentive system undoubtedly reflect its unique identity or the egalitarianism of Finnish culture, other companies in other parts of the world should ponder Nokia's ability to move ideas across units and into its underlying fabric.

KEEPING IDEAS MOBILE

Mechanisms other than incentives also help diffuse ideas throughout Nokia. NVO, for example, is overseen by the Nokia Ventures Board, most of whose 15 members—including the president of NMP (Matti Alahuhta) and of Net (Sari Baldauf)—come from the business groups. The board reviews NVO initiatives as they go through successive funding gates, thereby ensuring that they are accountable to the core business and don't drift from the shared agenda.

The opportunity to develop ideas into businesses inspires engineers and other employees to cross organizational boundaries, and this movement of employees throughout the company also helps diffuse the knowledge that NVO was created to promote. When openings occur, they are posted on a Nokia intranet. Managers are not allowed to prevent their people from transferring to other units, and hiring managers can't go headhunting or give people special inducements to move within the company. Nonetheless, in most cases teams move into NVO along with the ideas they conceive. Once an NVO venture has been developed, the people who worked on it are expected to return to the mainstream. Except for a few managers, NVO has no permanent staff.

Nokia relies heavily on personal networks. One of the main qualifications for membership on an NVO team is credibility in the eyes of the larger company. People build support for ideas by circulating them, since widely known ideas have the best chance of encountering a favorable milieu for development. The result is a system that encourages innovation throughout the company; as Net's Sari Baldauf says, "If you've got a good idea at Nokia, it will be hard to find someone who will stop you from acting on it."

THE PROCESS AT WORK

The history of Nokia Internet Communications (NIC), NVO's largest initiative by far, illustrates the process at work. NIC began with a group of engineers who moved to NVO to commercialize the Wireless Application Protocol (WAP) technology they had developed at the Nokia Research Center. They were soon joined by staff from Net, and to gain outside expertise, NIC also made several acquisitions. As Markku Rauhamaa, vice president of its Wireless Software Solutions group, explains, NIC cooperates with the main business groups: "We don't have any problem [doing] things for NMP. There is such a high demand for our expertise there. . . . Typically, the challenges come from resource limitations."

Meanwhile, NIC generates several hundred million dollars a year in revenue. Nokia intends to move NIC out of NVO soon, either by integrating NIC with one of the company's existing businesses or by making it a business entity in its own right. The movement of ideas comes full circle.

後記 超越資訊

從一開始，我們就說過要避免急就章的解決之道。經過兩百五十多頁的討論，筆者仍然沒有什麼萬靈丹可以提供。寫這篇後記是追隨編纂字典的開山祖師約翰遜博士（Dr. Samuel Johnson）的精神，他將自己的小說《拉塞列斯》（*Rasselas*）的最後一章稱為「沒有結論的結論」。然而我們在這裡，想要把本書裡一些貫穿數章，但沒有一章特別強調的幾個脈絡，再拿出來檢視一番。

資源與限制

首先，我們要強調資源與限制的複雜性。資源和限制就如同好人和壞人，不是全無交集的二分法，兩者有時會出現令人難以分辨的重疊。本書提出批評的許多案例，都有忽視這種重疊性的缺失。在某些案例裡，開發新技巧和新技術的目的，是為了克服表面上（物件、組織、實務、體制）的限制，卻破壞了潛藏在限制裡的豐富資源。碰到這種情況，占上風的往往是舊資源，令科技專家和未來學家徒呼負負。對新科技頑抗的例子聽起來固然有趣，但或許也反映出一個普遍的科技設計問題。

尤其是視野狹隘，只看到資訊，認為它可以脫離背景環境獨立存在，且對於數位世界深信不疑的那些人。在他們眼中，資訊受到的限制如同阻礙血液循環的血栓塊，應當要除去，絕不可保留。還記得第七章中帶醋味的信件，醋的味道不但打破杜奎德對那些信件的詮釋，也否定他對資訊與載具、背景與內文的分野等想當然爾的假設。

區分限制與資源，就如畫分背景與內文一樣：在我們熟悉的東西上進行，尤其特別困難，因為我們已經習慣仰賴不斷出現的科技限制，來提供社會和體制上的資源。因此，紙張對資訊的流通可能是限制，但是讀者和作者已經使紙張成為製造、形塑、證明、詮釋，甚至保護資訊的有力資源。紙張的例子告訴我們，想要做能夠普及推廣的設計，就先別急著否定明顯的限制，應該先考慮社會大眾是否已把這個限制發展成社會資源。

設計者更可以設法把限制化做資源。舉一個具體的小例子：全錄帕洛奧圖研究中心的加油添醋（*Macap*）計畫。這個計畫的出發點很簡單，和很多地方一樣，研究中心保留了不少外面專家來演講的錄音帶和錄影帶，不知道有多少捲，有多少個小時，可是極少派上用場。從錄影帶或錄音帶去聽演講就是比現場聽困難，也無法像閱讀文件那樣略讀。可是，用傳統方法把演講內容謄寫或摘錄下來，又極費功夫，所以研究中心保存的帶子幾乎沒有人利用。

加油添醋計畫就是想用動態方式為那些帶子加上註記，比方把在場聽眾所做的筆記附上去，並且加上時間戳記做為索引。使用者便可以選定某個註記，然後直接切到帶子上這個註記所在的位置。這個計畫還加上背景噪音做為資源，或許有人覺得噪音是有礙聽講的限制，消除都來不及，怎麼還當做資源。其實觀眾發出的雜音、笑聲及掌聲等等，是一種集體社會反應，可以充當索引，告訴我們哪些地方值得一聽，哪些可以跳過。

筆者在本書中一直想要強調的是，限制與資源往往互為表裡，它可以是紙張、噪音等具體物件，也可以是社會團體、組織及體制。我們有充分的理由去改變這些限制，而新科技現在也給了我們必要的工具。然而，忽視限制所隱含的豐富資源，不會使限制消失，徒然更顯得它一無是處。反之，一旦了解限制的正面意義，它就不再是阻力，而是指引方向的明燈。舉例來說，在第八章討論過，若忽略在教室面對面學習所能提供的資源，即「偷」知識和集體建構對知識的了解，那麼遠距教學科技的基礎也將動搖，而了解那些資源或許有助於開發更厲害、對社會而言更有用的教學科技。

我們也相信，忽視這些資源可能導致科技為距離而犧牲互惠，為自主而犧牲架構。互惠與架構難免包含著限制，但那可能是資源性的限制。

體制的演進

值此強調個人自由的時代，體制常常被比做對個人自由的限制，而且是食古不化、僵硬固執的限制。可是，體制是人類創造的產物，其意義絕不止於此。體制會隨著人類改變而改變。它會為適應社會需要而調整。如果不談體制的用處和調適力，就很難掌握社會變遷的大方向。矛盾的是，指責體制最力者往往是受惠於未來變局最多的人。

社會批評家雷蒙·威廉斯（Raymond Williams）認為，社會始終在整合主流、殘餘及新興體制的勢力。他的說法提醒我們注意到體制演進的本質。一個時代的主流體制多半是最明顯，且影響社會最直接的。自由市場、全民民主、智慧財產等，正是當前我們耳熟能詳且普遍討論的主體。

體制不是自然而就發生。任何體制的產生都是為了取代舊制。比方，在很多地方，自由市場和全民民主出現之前，是重商主義和專制政體。智慧財產權體制也衍生自其他財產權。新體制出現後，殘餘舊體制不會立刻消失。它們陰魂不散，時而讓人感覺到它們的存在。例如，反自由貿易就是重商主義的延續，階級意識就是專制政體的餘毒。但是，因為大眾誤以為舊體制已不復存在，便不易察覺或明白它所造成的影響。但願世人能領悟到體制是演進的，不是單純的生與死。如此就不會有人再相信終結論，至少能滅它一點威風。

上述有關體制的論述或許失之抽象模糊（要寫這個主體本來就不容易），但是體制在興衰的各個階段，確實強烈地左右著人類的行為和技術，因此我們必須去理解它。當人們為舊體制的沒落和新體制的興起而歡呼時，總是值得回頭看一看，有沒有被視為當然以致忽略的舊體制。

例如，許多人在高談闊論商業和金融的新遠景，但「損益欄」卻已有六百年歷史的複式簿記的遺物。賺與賠的會計體制仍然對我們的思考有極大的影響力。企業改造大師可能要我們「昨日之事譬如昨日死」，但是身陷企業改造之中的人，很少能夠撇開損益不談。

又如人人把電子商業新經濟、網路力量及新興市場掛在嘴邊，可是別忘了有多少人預言廣告會與我們長相左右。許多網路事業的開辦計畫，都建立在大企業會持續經營，會投入大量經費做網路廣告的假設上。可是，同樣的開辦計畫又標榜淘汰大企業，讓消費者

享受「完美的」資訊。這些計畫與線上課程不相上下，都是既想要摧毀又想要保留同一體制。用第一章努恩柏的比喻加以引申，就是他們想炸掉水壩，又想在水上泛舟。

對於影響人類生活甚深的一些體制，我們也常容易視之為已經過氣。有些律師會推動「虛擬空間法律」的概念。但是那並不代表真實世界的老式法律已超過有效期限。電子商務在保證、支票、合約及防偽方面，仍然需要仰賴頗為傳統的法律。

碼中之碼

不少人認為，在資訊時代，著作權法連「殘餘」都談不上。著作權主要是因文件而形成的現象。社會靠紙張的局限性，建立起一個涉及不少資源的體制。著作權法的執行，多半建立在文件不易複製的基礎上。想追究用手抄方式抄襲幾行文字的個人，當然是小題大作。可是，大規模的複製印刷發行，就值得採取法律追訴行動。

數位科技動搖了著作權的基礎。要印製一千份微軟的Word手冊，可能需要勞師動眾，但是從個人電腦散發成千上萬份Word軟體，只要手指輕按一下即可。不過，現在宣判著作權的死刑還太早。比爾·蓋茲仍然在靠它累積財富，將來大概也不會變。這是因為在網際網路上複製和散播固然輕而易舉，但是代理軟體也不難追蹤到大量傳送數位檔案的來源。以往實體紙張的制約作用，如今由數位物件內含的軟體碼負責執行。

針對部署約制軟體的現象，哈佛法學院列席格(Larry Lessig)提出「碼中之碼」一說。標示合法的記號，現在不由具體物質的資源提供，而是靠軟體碼來區別。從這個角度來看，著作權和著作權相關體制並未消失，而是正在突變。因此，著作權的數位式符碼化，有可能改變原本靠紙張維持的平衡。

著作權向來是公眾利益與個人私利之間，一種矛盾且不斷變動的妥協。名義上，著作權法是為公眾知的權利而設，可是它又給著作者不將作品公諸於世的權利。著作權一方面保障個人的智慧財產，一方面又規定在若干年後公眾有自由使用權。社會和著作權所有人在利益交換。

軟體碼同時保障了財產和公共利益。它幫助我們精確地確定，什麼人可以使用某個數位文件，以及如何使用。它可以防止重複聽取同一首曲子，或是把某文件貼入另一文件中，或是將某影像傳送給友人。此外，它可永久阻止公眾取用受到著作權保護的物件。「公有領域」(public domain)和這個領域內的公共財，在新的密碼化平衡中不可能存在。

眼下這些改變對哪一方有利還看不出來。有些人認為，軟體碼表面上是為維護個人創新，其實對大型組織比較有利，因為大型組織能掌控那些管理符碼和執行符碼必要的軟、硬體。如果他們的看法是對的，社會好像又在走回頭路。社會花費了一百五十多年在智慧財產權上角力，好不容易從出版商手中拿到主控權，還給各個著作人。如今，儘管網際網路去中介化的說法甚囂塵上，社會卻可能回到出版商和企業擁有著作權的時代。

這個變動不居，始終沒有答案的辯論，對筆者而言主要的意義是在凸顯，資訊和科技的話言可能使大眾看不清社會及體制問題。資訊被說成是超脫於體制、組織及物質限制之外，但實際上資訊科技改變了與智慧財產有關的體制。前加大柏克萊分校圖書館館長李曼

(Peter Lyman) 就認為，注重智慧財產的資訊面，輕乎其社會面與體制面，並不會令社會與體制問題消失，只會導致不良的政策、法律及制度。

知識生態的挑戰

無視於體制的存在，必然造成大眾忽略體制也需要因地制宜。第六章談到的區域知識生態，正顯現出這方面的盲點會產生弊端。

有兩種終結論使體制未受到應有的重視。一是體制終結論：既然體制來日無多，何必浪費精神。可是當我們認為體制必死無疑，它卻僥倖存活，難保不趁我們不注意時反咬一口。其次是距離終結論，即主張區域優勢根本不存在。事實上，區域優勢並非無稽之談。它是一個重要經濟因素，表現在區域體制上，也反映出區域體制的特色。

對承認區域和區域體制很重要的人而言，下一個重大課題便是：當大眾或組織必須在不同區域之間作業，特別是在體制差異很大的區域之間，那該怎麼辦？對本區域是助力的體制，到別的區域可能就成為掣肘。

舉一個大範圍的例子，美國與歐洲因個人資訊而起的齟齬，正顯示出將來的衝突會是什麼樣子。歐洲人正在研擬嚴密且限制重重的隱私權法，以防止企業洩露有關顧客的資訊。北美洲人對個人資訊的商業用途不那麼在意，卻更在乎政府使用個人資訊。如此對立的走向反映出不同的文化與歷史。歐洲人通常對企業比較有成心，比較信任政府。北美洲人則通常比較懷疑政府，相信企業。

現在，在歐美之間做生意，面臨這類問題的機率越來越大，原來表面上看似平順的全球貿易，暗藏著深深的鴻溝。跨區域與跨體制「系統」的貿易，素來都需要靠超越政府正式管制的組織創意，以及爭取時效來推展。這當中有許多有趣的權宜和變通，相信未來也會是如此。但是，堅決認為區域或體制不重要，距離和組織已是昨日黃花的人，要做這一類的創新想必有困難。想要遊走於公司、網絡、社群、區域及體制之間，而那似乎是創新發明的要件，第一步就得承認它們是有界線的。

以上有關資源與限制、架構與自主、距離與互惠，以及有關主流、殘餘及新興體制的相關議題，都會影響到設計，從數位家電到跨國組織和體制的設計都包括在內。本書從一開始就提到，以我們目前的生活環境，每個人都是設計品的生產者和消費者。所以，這些問題和問題背後的意涵也影響到每個人，而且影響是發生得越來越快、越來越迫切，這是過去不會有的現象。筆者在前面也已經表明，我們沒有什麼善策良方可以建議。我們只想不厭其煩地再重複一次，如果不能從大處著眼去面對問題，也就是如果對於周邊和邊緣、實務和社群、組織和體制，視若無睹或掉以輕心，那麼想要解決問題將是難上加難。

庇護

如果唐納·川普 (Donald Trump) 買下大峽谷準備建一座主題娛樂園，大部分的人可能都會目瞪口呆。但是，如果他出個好價買下大峽谷，準備將整個自然生態保護起來，那又如何？如果這一片大自然的鬼斧神工落入私人手中，有什麼差別。如果交易條件是可以出售高價入場券，或者是像阿拉斯加有些公有地的爭論一樣，可以取得開採自然資源的權利，那又如何？

對大部分的人來說，公共信託的大峽谷與其他政府設立的保護措施是非常神聖不可侵犯的。知識資產是否也需要相似的保護，決定私人權利的限制？如果答案是肯定的，人類基因組圖譜會是一個很好的討論起始點。有許多原因，從實用主義到道德基礎，證明人類基因是非常強力的資源，應該有特殊地位。但，當我們看到一個知識領域中的大峽谷時，我們如何知道它就是？是否應建立一些評斷標準，來決定概念領域的保護範圍？一個有用的原則是保護資訊基礎設施有其必要，特定領域裡的人會需要特定的前瞻想法、標準、語言與工具，才能進行工作。

在有形資產的範疇中，我們會容許建造基礎建設的企業擁有獨占地位，像電話或電線就是很好的例子，但是資訊基礎設施並非由巷道類這種有形的項目組成，而是由像道路規則這一類無形的工具建構。知識經濟裡的參與者將會明瞭，總有一天，資訊基礎設施必須是免費共享的。不論是電信通訊或是打字機的鍵盤，在開發新科技時標準非常重要，新科技要能成功，先決條件是機器必須與其他的機器互相溝通，從飛行員與控制台的通話型態到電器設備的插頭，我們的開發必須基於共同的形式基礎。

雖然，有時以加速發展是充滿誘惑的理由，但讓私人所有權來影響這一類的知識最終會讓社會變得毫無生產力。比方說，傳真機使用來相互連接的語音辨識信號就是一種資訊基礎設施，雖然，就貢獻程度來說，發明人拉姆森所得到的權利很合理，但是他不應得到獨占權利，不應從傳真機製造商手中收取特許使用費。

國家公園系統早期的發展凸顯了未來幾年內我們將會面臨的衝突壓力。一九〇〇年代初期，保留大規模土地的決策常與短期的發展目標直接抵觸，其中最著名的抗爭，要屬工業鉅子安德魯·卡內基 (Andrew Carnegie) 與穆爾在優勝美地國家公園 (Yosemite National Park) 的水庫案，穆爾反對這項計畫，卡內基為此嘲弄他迂腐。卡內基是這樣說的：「一個城市對潔淨飲水供應的絕對需求竟然會為了幾棵樹或是風景而打折扣，無論自然景色有多美，這種想法都太愚蠢了！」卡內基最後在水庫案中贏得勝利，但私人侵入公有土地進行開發的模式也進駐美國的國家公園裡。美國市民協會 (American Civic Association) 主席賀若斯·麥克法蘭 (J. Horace McFarland) 在一九一六年國家公園正式成立の場合中大聲疾呼：「這些公園並非自然存在，他們之所以出現，是因為有許多激進的人在試探是否可能從公眾的手中奪取這些重要資產。」

分區

如果說，保護可以確保某些重要的知識可以供大眾公開使用，另一類的知識可能就需要規範，劃分出一塊領地，可以讓私人擁有，但必須加上限制，不能侵犯到他人的權利，也不能侵蝕到該領域中公眾同意的特質。

伊利諾理工學院 (Illinois Institute of Technology) 兩位哲學家薇薇安·威爾 (Vivian

Mei)與約翰·史耐普(John Snapper)指出,我們對於所有權的概念太不明確。可以確定的,某件物品的擁有者有權決定誰可以使用這項物品,以及如何使用,但是控制的形式並不只有一種。威爾與史耐普提到,當一個房屋所有人主張權利時,他(她)可以住在裡面,可以出租,也可以出售,但他(她)可能無法在屋頂上建個水塔,甚至有的社區裡還不能自己選擇外牆顏色。同樣的,一本書的擁有者可以出借、出售甚至燒了那本書,但他(她)不可以在未知會作者的情況下抄襲任何文字。

分區是一種工具,用來保障大環境的關鍵面向,不至於被少數所有者的惡意行為破壞。分區規則來自於集體認知:住宅區裡若有工廠出現,將對四周的居住環境產生不可回復的影響;歷史建築區中若存在現代化摩天大樓,也將會影響周遭的品質。以這樣的想法出發,當我們想要在知識經濟體中建立更公平的安排,也可以利用分區的概念,對那些即便是容許私有的智慧財產權,也可以強制某種程度的開放、降低費率或是提供其他保證。有形世界中,類似的安排相當普遍,像保留地役權、保護景觀或是維護大眾進入海灘的權利都是。

分區法可以有效地抑制排他獨占權的病態,這是智慧資產所有權最不為人所喜的特徵,但最常被過度使用。在概念領域中,排他性像是一種疾病,任何與它接觸過的事物最後都會被感染。如果悟性高的玩家不斷地利用手中掌握到的智慧資產牟取短期暴利,我們將會看到越來越多的排他性出現。

概念領域的如何分區?舉例來說,針對某些與公眾利益息息相關的領域,如健康護理,可以強迫特定型態的專利釋出使用執照;同樣地,如果使用目的並非帶有營利性,應可免除排他權利的適用。

在網路世界中,可能有些分區方法會特別有效,比方說,可以依據對象的不同分別建立使用規則與取價條件,像可以分成學校、公共機構與低收入社群等幾類。所有的努力,成敗關鍵在於能否創造引人注目的對話,建立集體規則,並讓特定領域中公眾對私有權利的監督行動合理化。

反托辣斯

我們已經看到,私人所有權可以讓「知識大亨」們手中握有前所未見的強大權力。當我們在思考如何捍衛系統的生產力時有一個非常重要的原則,就是要捍衛公平競爭。在現有專利系統滿載的前提下,我們必須重新審慎思考,至少必須先做到政府下放權力形成的獨占地位。智慧財產國度與其他並無不同,壟斷是最後的手段,而不應主導產業政策;但在專利系統中,情況卻正是如此。

之前已經說明,概念上的獨占不必然能提升產能,事實上,很有可能讓開發與創新的腳步停滯不前。此外,壟斷會帶來難解的公平性與合理性問題,看看美國專利局在概念領域中廣發獨占性專利的情况,以及不對自然現象的發現與實質發明差異訂出明確區隔的作法,我們可以窺見一二。

許多觀察家開始調整焦點,注意到專利局發出獨占性權利的數量規模。很明顯的,兩端都已出現最壞的狀況。在發展空間廣大的領域裡,範圍廣泛的概念專利出現會使競爭性發展就會受阻;如果業界的空間太小,也同樣會引起問題:圈內任何人要達成目的之前,必須先蹚一趟渾水,針對使用執照或是特許費進行交涉,這會讓整體產業的未來遠景為之窒息。

知識的戰爭 ● 213 ● 第十一章 最珍貴的資產

從電力到電話，一直以來，科技基礎設施常常會形成獨占的局面，而且還不斷地尋求擴大的機會。我們的政府一直在監督那些受到獨占威脅、造成不公平競爭的市場，並設法干預。今天的問題，就像進行中的微軟反托拉斯案，是我們尚未建立起清晰的意識，還不清楚反托拉斯在知識經濟裡代表什麼意義。我們必須讓反托拉斯法的意向再度復甦，明確地限制資訊基礎設施中的壟斷行為，獨占代表權力集中的潛在威脅。

概念國度中的市場常常失靈，一旦市場機能失效，我們所能依賴的最佳模式就只有民主。民主方法機構可以收斂過度的獨占所有權，堅持「有福同享，有難同當」。民主系統為我們催生了獨特的公共機構，因為有民主的想法，建立開放給所有人的圖書館，也支持了公共教育與平等機會的主張。美國郵政服務（U.S. Postal Service）雖經常是別人玩笑的對象，但也與民主原則緊密相結合。美國郵政盈虧自負，但它利用交叉補助的方式維持平價、高品質的國內郵遞服務，讓所有人都能以一定的價格享受郵政服務。

這類的系統之所以重要，是因為他們對「公眾」概念的維護；像是提供郊區的公車就是概念的具體化。我們要做的，是在設定知識資產所有權的新規範時，將慷慨、民主的公眾概念彰顯出來。

在這關鍵時刻，作為民主系統下的一份子，我們所面對的任務，是要重新定義、重新捕捉對文化遺產的共享權利，定下民主的原則，指引共同概念的使用，並且抵禦私人權利的侵入。就如世界各國一九四八年在聯合國國際人權宣言（Universal Declaration of Human Right）中的背書，國際社會已經體認，知識與文化、教育與監督是緊密相連的。這項聲明部分是這樣說的：「每個人都擁有思考與表達的自由，這也應包括在不受侵擾下擁有意見的自由，以及從任何媒體或領域中尋找、接受與傳播資訊與想法的自由。」大戰後，這「接受與傳播資訊與想法」的權利在無疑是對抗集權主義國家檢查制度的最佳對策；在知識取得越來越不易的時代，這的確是偉大的理想，讓我們在知識的寶庫中可以暢行無阻。

最後，我們必須樹立的原則，是確立公眾能獲得公共概念的優先性，這遠比科技發展的速度或是知識資產所能賺取的利益來得重要。這項原則事關重大，因為，無論我們是鑽研人類基因組，是泅泳在網際網路，還是利用數位科技在展示蒙娜麗莎，我們都是處在一個民主社會中，有權利塑造自己的未來。此外，無論我們面對是公有地所遭遇的威脅、是乾淨飲水的獲得，還是資訊的取得，我們都有權利與責任來保護公眾領域裡的重要資產。如果失敗了，公眾的心聲將會被放棄、侵蝕終至完全消失不見。今天我們的社會已經非常富裕，但是，在一個民主社會中，或許，最珍貴的資產還是公眾的聲音與權利。

If the road ahead is this clear, why are so many companies straying or falling by the wayside? We believe the reason is that the instruments companies use to set their targets, measure their performance, and hand out rewards are faulty. In other words, the markets are full of distortions and perverse incentives. Of the more than 60 specific forms of misdirection that we have identified,³ the most obvious involve the ways companies allocate capital and the way governments set policy and impose taxes. Merely correcting these defective practices would uncover huge opportunities for profit.

Consider how companies make purchasing decisions. Decisions to buy small items are typically based on their initial cost rather than their full life-cycle cost, a practice that can add up to major wastage. Distribution transformers that supply electricity to buildings and factories, for example, are a minor item at just \$320 apiece, and most companies try to save a quick buck by buying the lowest-price models. Yet nearly all the nation's electricity must flow through transformers, and using the cheaper but less efficient models wastes \$1 billion a year. Such examples are legion. Equipping standard new office lighting circuits with fatter wire that reduces electrical resistance could generate after-tax returns of 193% a year. Instead, wire as thin as the National Electrical Code permits is usually selected because it costs less up-front. But the code is meant only to prevent fires from overheated wiring, not to save money. Ironically, an electrician who chooses fatter wire—thereby reducing long-term electricity bills—doesn't get the job. After paying for the extra copper, he's no longer the low bidder.

Some companies do consider more than just the initial price in their purchasing decisions but still don't go far enough. Most of them use a crude payback estimate rather than more accurate metrics like discounted cash

companies were demanding from energy efficiency was 1.9 years. That's equivalent to requiring an after-tax return of around 71% per year—about six times the marginal cost of capital.

Most companies also miss major opportunities by treating their facilities costs as an overhead to be minimized, typically by laying off engineers, rather than as profit center to be optimized—by using those engineers to save resources. Deficient measurement and accounting practices also prevent companies from allocating costs—and waste—with any accuracy. For example, only a few semiconductor plants worldwide regularly and accurately measure how much energy they're using to produce a unit of chilled water or clean air for their cleanroom production facilities. That makes it hard for them to improve efficiency. In fact, in an effort to save time, semiconductor makers frequently build new plants as exact copies of previous ones—a design method nicknamed “infectious repetitis.”

Many executives pay too little attention to saving resources because they are often a small percentage of total costs (energy costs run to about 2% in most industries). But those resource savings drop straight to the bottom line and so represent a far greater percentage of profits. Many executives also think they already “did” efficiency in the 1970s, when the oil shock forced them to rethink old habits. They're forgetting that with today's far better technologies, it's profitable to start all over again. Malden Mills, the Massachusetts maker of such

products as Polartec, was already using "efficient" metal-halide lamps in the mid-1990s. But a recent warehouse retrofit reduced the energy used for lighting by another 93%, improved visibility, and paid for itself in 18 months.

The way people are rewarded often creates perverse incentives. Architects and engineers, for example, are traditionally compensated for what they spend, not for what they save. Even the striking economics of the retrofit design for the Chicago office tower described earlier wasn't incentive enough actually to implement it.

The property was controlled by a leasing agent who earned a commission every time she leased space, so she didn't want to wait the few extra months needed to refit the building. Her decision to reject the efficiency-quadrupling renovation proved costly for both her and her client. The building was so uncomfortable and expensive to occupy that it didn't lease, so ultimately the owner had to unload it at a fire-sale price. Moreover, the new owner will for the next 20 years be deprived of the opportunity to save capital cost.

If corporate practices obscure the benefits of natural capitalism, government policy positively undermines it. In nearly every country on the planet, tax laws penalize what we want more of—jobs and income—while subsidizing what we want less of—resource depletion and pollution. In every state but Oregon, regulated utilities are rewarded for selling more energy, water, and other resources, and penalized for selling less, even if increased production would cost more than improved customer efficiency. In

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water laws encourage inefficient water consumption. Additionally, in many towns, inefficient use of land is enforced through outdated regulations, such as guidelines for ultrawide suburban streets recommended by 1950s civil-defense planners to accommodate the heavy equipment needed to clear up rubble after a nuclear attack.

The costs of these perverse incentives are staggering: \$300 billion in annual energy wasted in the United States, and \$1 trillion already misallocated to unnecessary air-conditioning equipment and the power supplies to run it (about 40% of the nation's peak electric load). Across the entire economy, unneeded expenditures to subsidize, encourage, and try to remedy inefficiency and damage that should not have occurred in the first place probably account for most, if not all, of the GDP growth of the past two decades. Indeed, according to former World Bank economist Herman Daly and his colleague John Cobb (along with many other analysts), Americans are hardly better off than they were in 1980. But if the U.S. government and private industry could redirect the dollars currently earmarked for remedial costs toward reinvestment in natural and human capital, they could bring about a genuine improvement in the nation's welfare. Companies, too, are finding that wasting resources also means wasting money and people. These intertwined forms of waste have equally intertwined solutions. Firing the unproductive tons, gallons, and kilowatt-hours often makes it possible to keep the people, who will have more and better work to do.

Recognizing the Scarcity Shift

To the end the real trouble with our economic compass

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nature still abundant—the conditions that helped to fuel the first Industrial Revolution. At that time, people were relatively scarce compared with the present-day population. The rapid mechanization of the textile industries caused explosive economic growth that created labor shortages in the factory and the field. The Industrial Revolution, responding to those shortages and mechanizing one industry after another, made people a hundred times more productive than they had ever been.

The logic of economizing on the scarcest resource, because it limits progress, remains correct. But the pattern of scarcity is shifting: now people aren't scarce but nature is. This shows up first in industries that depend directly on ecological health. Here, production is increasingly constrained by fish rather than by boats and nets, by forests rather than by chain saws, by fertile topsoil rather than by plows. Moreover, unlike the traditional factors of industrial production—capital and labor—the biological limiting factors cannot be substituted for one another. In the industrial system, we can easily exchange machinery for labor. But no technology or amount of money can substitute for a stable climate and a productive biosphere. Even proper pricing can't replace the priceless.

Natural capitalism addresses those problems by reintegrating ecological with economic goals. Because it is both necessary and profitable, it will subsume traditional industrialism within a new economy and a new paradigm of production, just as industrialism previously subsumed agrarianism. The companies that first make the changes we have described will have a competitive edge. Those that don't make that effort won't be a problem because ultimately they won't be around. In making that choice, as Henry Ford said, "Whether you believe you can, or whether you believe you can't, you're abso-

試科目	產業經濟學	所別	科管所博士班	考試時間	月	日	上午
					星期		下午

產業經濟學

一、爲什麼市場上的供應商總是有動機進行價格或產量上的聯合（兩家如同一家親）的行爲？爲什麼政府要藉公平交易法限制聯合行爲？

口說無憑，請自行設計一個簡單的數理模型來加以說明。（30）

二、如果一個產業的投入因素中「知識」所佔的比例極高，請問這個產業的結構與競爭行爲會有哪些特性？（20）

三、如果一個產業的產出在消費的時候需要許多「知識」或能力，請問這個產業的結構與競爭行爲會有哪些特性？（10）

四、何謂「網路外部性」？對產業的競爭有哪些影響？（20）

五、廠商的研發活動如果也進行聯合行爲，是否也該禁止？試討論之。（20）