前沿科技英语阅读文选

——机电工程篇

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前　言

理工类各专业的学生往往在通过四级考试后中断了英语学习，即使继续学习专业英语，也由于目前各院校选编的教材时效性滞后，内容陈旧，学生在专业阅读中语言和专业脱节，因此或者忽视了专业语言的培养，或者忽视了科技阅读中的专业价值。

针对这些问题，国防工业出版社组织了一批长期从事专业英语教学和精通英语的专业研究人员，精心编译了这套《前沿科技英语阅读文选》。本丛书选编的内容均是由业内资深研究人员通过对近期大量科技文献的严格筛选而选定的，主要选自2004年以来出版的本专业国际核心期刊、著作，内容涉及本专业前沿领域的热点问题。每篇文章的注释部分包括专业导航、词汇注释、难句释疑和译文点拨。

科技英语的阅读和翻译既需要专业知识，也需要扎实的语言功底。尤其是当那些日常生活中常用的词作为某一领域中的专门术语出现时，理解起来更要小心，这些词虽然看起来很浅显，很熟悉，但如果简单地用日常用语中的常用义来解释专业术语，或者望文生义，往往会闹出“牛头不对马嘴”的笑话。比如有人把 basic pig 翻译为“基本猪”——这究竟是什么意思呢？原来是“碱性生铁”。

本套丛书的编者既有长期从事专业英语教学和英语语言研究的一线骨干教师——他们具有比较丰富的编写教辅材料的经验，也有精通英语的本专业研究人员——他们熟悉专业领

域，保证了注释的专业性和准确性。通过具有各学科背景的编者的倾力合作，本丛书尽可能将专业学习和语言学习有机地结合起来，将理论性和应用性有机结合起来，为读者提供一套取材新颖、信息量丰富的科技英语阅读材料。

本系列丛书所选文章难度适中，适合于通过四级考试后的理工科本科和研究生作为补充阅读和专业学习，也对论文写作具有参考价值，还适合于相近程度的科研人员提高英语水平、了解专业前沿信息。

目　录

1 Design Process
设计过程

专业导航

设计者在设计过程中要经历三个阶段。第一阶段，明确任务；第二阶段，概念设计；第三阶段，细节设计。本文讲的设计过程概括性强，具有普遍适用性。它不是针对某一个机械设备的设计，不涉及如何具体设计某种零件，而是强调设计的准备过程。这些准备过程为具体的机械设计能够顺利进行打下坚实的基础。本文注重的部分与其他常见的介绍设计的书籍不同，对什么是设计及如何设计进行了详尽细致的介绍，对设计工作具有一定的指导意义。

In line with the general strategy for tackling complex problems, the design process is split into a number of main phases, and each phase is then broken down into a number of steps. [1] Methods are suggested to help tackle each step.

It is important to emphasize that this systematic approach must be applied flexibly and adapted to suit the particular project being undertaken. It is not intended to replace intuition①, inventiveness② or insight; but rather to support and enhance these qualities by disciplining thinking and helping to focus concentration on important aspects

① intuition：直觉

② inventiveness：创造力

of the problem.[2]

In order to provide an overview, each phase is summarized briefly below. In subsequent sections of this article, the individual steps of Clarification of the Task and Conceptual Design are described in more detail.

Clarification of the Task. The starting point for the design process is an idea or a market need, often stated in vague, and sometimes contradictory terms. Before the subsequent design phases start, it is important to clarify the task by identifying the true requirements and constraints①. The result of this phase is a design specification which is a key working document that should be continually reviewed and updated as the design develops.[3]

Conceptual Design. In this phase, concepts with the potential of fulfilling the requirements listed in the design specification must be generated. The overall functional and physical relationships must be considered and combined with preliminary embodiment features. The result of this phase is a concept drawing.

Embodiment Design. In this phase, the foundations are laid for detail design through a structured development of the concept. In the case of mechanical product, the result of this phase would be detailed layout drawing, showing the preliminary shapes of all the components, their arrangement and, where appropriate, their relative motions.[4]

Detail Design. Finally, the precise shape, dimensions and tolerances of every component have to be specified, and the material selections made, or confirmed. There is a close interrelationship between the shape of a component, its material and the proposed method of its manufacture. The result of this phase is detailed manufacturing

① constraint:限制,约束

instructions. The detail design phase is no less important than any of the others. Many excellent concepts have failed in the market due to lack of attention to detail.

Clarification of the Task

The steps of the task clarification are the following: The market need is transformed into a specification by identifying the "real need" and defining a problem statement, refining that statement to identify requirements which are collated in a product specification.

Identify Real Need

To avoid solving the wrong problem, it is wise to spend some time identifying the true needs and preparing a clear solution-neutral problem statement which avoids any indication of how the problem should be solved.[5] A useful technique is to systematically raise the level of abstraction using the following steps:

- Eliminate requirements that have no direct bearing on the main functions and essential constrains.
- Transform quantitative statements into qualitative ones.
- Formulate the problem in solution-neutral terms.

Abstraction broadens the range of possible solutions described by the problem statement by eliminating unnecessary constrains. It also encourages the designer to think more about general concepts and less about issues relating to specific solutions. As an example, consider the problem statement:

Design a cylinder-type lawn-mower to cut grass.

This statement clearly indicates the direction of the solution but suggesting both the type of device and that the grass must be "cut". The size of the search field is thus restricted unnecessarily from the outset. An improved statement, at a higher level of generality, is *Devise a means of keeping the grass short.* This statement defines a broader problem and encourages a wider range of possible solution concepts.

Identify Requirements

Having identified the real problem, it is wise to limit the search field by preparing a detailed list of all the requirements and constrains. Where possible use quantified statements, for example, "Weight not to exceed 100 N" is much better than "Low weight". This appears to contradict the removal of quantitative statements when identifying the real need. However, when the real need has been identified such statements are essential to communicate acceptable performance limits for the new product.

Not all the requirements can be quantified easily and value judgments will be involved. For example, it is difficult to quantify[①] factors such as appearance, ease of operation, etc. An ideal solution would meet all the requirements, but this is seldom possible with the resources available and compromises must be made. To aid selection and evaluation, it is useful to identify each statement as being either a demand or a wish.

- Demand (D)-ideally a requirement which must be fulfilled. If a proposed solution fails to meet a single demand, then it should be rejected.
- Wish(W)-ideally a requirement which will improve the value or quality of a solution, ie desirable but not essential. It is useful to indicate the weighing (Wt) of wished as high(H = 3), medium (M = 2) or low (L = 1) importance.

Although a relatively simple idea, in practice categorizing[②] requirements as either demands or wishes is not always that easy. It

① quantify:量化

② categorize:分类

may be demand that a certain minimum requirement is met, e. g. for legal reasons, but a wish that minimum requirement is exceeded but a certain amount, e. g. for marketing reasons. The dividing line can be a little fuzzy①—however the concept is valuable as it forces one to think about the status and importance of the various requirements. [6]

Elaborate Specification

The requirements and restrains are best compiled into a comprehensive description, or specification of the product to be developed. The specification should be clear, correct and as complete as possible. It should list all the problems and specific requirements in such a way that the reader is clear about the tasks to be performed. Demands and wishes should be clearly identified along with a keyword to uniquely identify each requirement.

In theory, since a solution must meet all the demands, preliminary② selection from several possible solutions should be based on the demands. A proposed solution that does not meet all the demands should not proceed to the next stage of the design process. Those solutions that do not meet all the demands must, usually after further work, be evaluated and best selected. In theory, evaluation at this stage is based on the wishes. The aim is to find the solution with the highest value and quality. To keep things simple at this stage, the demands in the specification will provide the criteria for a preliminary selection and evaluation.

Conceptual Design

A concept is now developed from the specification by identify ing the functional requirements for the product, generating possible

① fuzzy:模糊不清

② preliminary:开端的,最初的

concepts and selecting the most promising. All technical devices can be analyzed in terms of the flows① and conversions of material, energy and information which take place within their system boundaries. [7] The first step is to identify the overall function. The overall function follows directly from the solution-neutral problem statement. For our grass cutter, the overall function might be shorten grass.

The overall function can now be broken down into an appropriate number of smaller functions which indicate the logical and physical relationships between the flows and conversations of material, energy and signals. There is generally an identifiable main flow which dominates the situation, plus a number of supporting auxiliary flows. The character of a function is usually indicated by "imperative② + object", for example "Adjust settings" or "Convey cuttings". The arrangement of functions can be varied to determine the most favorable function structure, remembering that the solution must eventually be embodied.

There are two different types of function structure: system function structure and process function structure. Many devices are used as part of a process and in this case a process function structure showing a sequence of sub-functions can be illuminating③. The important thing is to use the method flexibly so that it provides as much help as possible.

It is possible to produce a very detailed function structure, breaking each function down into smaller and smaller units. However, the procedure should only be continued so long as it provides val-

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① flow:流通

② imperative:重要的,急需的

③ illuminating:富有启发性的

uable insights—to do it purely for its own sake is pointless. A useful guideline is to aim for between 10 and 20 functions. In theory the function structure should be created independently of any particular physical solution. In practice, one always has a tentative solution in mind. Now one or more solution principles must be found for every function. At this stage idea-generating techniques, such as Brainstorming, can prove valuable. Existing devices can be analyzed and useful ideas can be obtained from the study of natural systems. Once solution principles have been found, they can be combined systematically using a table of options.

Selection criteria for the combination are based on the demands identified in the design specification. If the demands have been correctly identified, then any combination of solution principles which fails to meet a single demand must be modified or rejected. [8] Simple yes or no decisions will suffice. The best time to do this is while creating the combinations and that does not include any combination which engineering common sense suggests. As a guideline, select not more that five sensible combinations.

The selection combinations will need to be firmed up into concepts before they can be evaluated to determine the best. The aim now is to determine which has the most favorable combination of additional features, and will thus provide the maximum competitive advantage.

Before staring a formal evaluation procedure it is worth noting down which concept you consider to be the best way and why. The formal method can then be used to "audit" your intuitive decision and provide new insights. If there is a difference between your first "guess" and the result of the procedure, it is illuminating to determine why.

Evaluation based on the whishes is identified in the design specification. More than simple yes/no answers are required to determine the relative merits of each concept. To do this each criterion must be weighted to indicate its relative importance. The wishes can be ranked as being of high, medium or low importance and given numerical weightings of 3, 2 and 1 respectively. More detailed approaches are possible, leading to a much finer gradation in the weightings, but the simple approach suggested above is generally adequate, particularly for preliminary evaluation.

Better than the datum ______ +1

Worse than the datum ______ −1

Much better than the datum ______ +2

Much worse than the datum ______ −2

The values may now be entered into an evaluation chart, where each value is multiplied by the appropriate weighting to give a weighted value and these are then summed to give an overall weighted value for each concept relative to the datum. The one with the highest overall value will, generally, be the best.

The technique does ensure a discipline approach and does provide a valuable guide to the relative merits of the concepts, but in the final analysis common sense should prevail. Check the outcome against your first guess and check that the chosen concept meets the demand and high-ranking wishes. The select concept must be presented in such a way that other people are convinced that it is worth committing to the embodiment design phase—clarity and brevity are essential.

难句释疑:

[1] In line with the general strategy for tackling complex problems, the design process is split into a number of main phases, and each phase is then broken down into a number of steps.

参考译文:

与解决复杂问题一样,设计过程可以分为几个不同的阶段,而且在每一阶段都有详尽的执行步骤。

译文点拨:

in line with:与某事物一样或一致。例如:in line with other research(与其他研究一样)。

split into 为"分成"。例如:For the purpose of the survey we have split the twin into three parts. 为了便于调查,我们把该镇分成三个部分。

[2] It is not intended to replace intuition, inventiveness or insight; but rather to support and enhance these qualities by disciplining thinking and helping to focus concentration on important aspects of the problem.

参考译文:

不是要取代直觉、创造力或洞察力,而恰恰是要借助于严谨的思辨,并得益于把精力集中在问题的重要方面来支持并提高质量。

译文点拨:

本句的基本结构是 not to do A but rather to do B。do A 指 replace intuition, inventiveness or insigh;do B 指 support and enhance these qualities by disciplining thinking and helping to focus concentration on important aspects of the problem,并且 B 部分中的 these 为前指词,指 intuition, inventiveness or insight。

[3] Before the subsequent design phases start, it is important to clarify the task by identifying the true requirements and constraints. The result of this phase is a design specification which is a key working document that should be continually reviewed and updated as the design develops.