ДОНСКОЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

УПРАВЛЕНИЕ ДИСТАНЦИОННОГО ОБУЧЕНИЯ И ПОВЫШЕНИЯ КВАЛИФИКАЦИИ

Кафедра «Иностранные языки»

Учебное пособие

«Основы теории научной коммуникации в грамматическом, лексическом и морфологическом аспектах современного английского языка»

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Аннотация

Целью данного учебника является учебно-методическое обеспечение системы постдипломного образования. Оно предназначено для аспирантов, соискателей, а также магистрантов гуманитарных и естественных специальностей. Учебник включает в себя основные тематические разделы, необходимые для подготовки к сдаче кандидатского экзамена по английскому языку. Он составлен в соответствии с программными требованиями и с учетом кросскультурных особенностей научной деятельности в вузах нашей страны и за рубежом.

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Оглавление

МЕТОДИЧЕСКАЯ ЗАПИСКА К УЧЕБНОМУ ПОСОБИЮ ДЛЯ АСПИРАНТОВ "ОСНОВЫ ТЕОРИИ НАУЧНОЙ КОММУНИКАЦИИ В ГРАММАТИЧЕСКОМ, ЛЕКСИЧЕСКОМ И МОРФОЛОГИЧЕСКОМ АСПЕКТАХ СОВРЕМЕННОГО АНГЛИЙСКОГО ЯЗЫКА"

Целью данного учебника является учебно-методическое обеспечение системы постдипломного образования . Оно предназначено для аспирантов, соискателей, а также магистрантов гуманитарных и естественных специальностей. Учебник включает в себя основные тематические разделы, необходимые для подготовки к сдаче кандидатского экзамена по английскому языку. Он составлен в соответствии с программными требованиями и с учетом кросскультурных особенностей научной деятельности в вузах нашей страны и за рубежом.

Настоящий учебник предназначен для аспирантов и соискателей, прошедших курс обучения иностранному языку в вузе по общеобразовательным программам в соответствии с Государственным стандартом Высшего профессионального образования.

Основными задачами обучения иностранному языку и изучения его аспирантами (соискателями) являются

- формирование коммуникативных компетенций для практического владения иностранным языком;
- развитие у аспирантов (соискателей) умений и навыков самостоятельной работы по повышению уровня владения иностранным языком с целью его использования для осуществления научной и профессиональной деятельности;
- реализация приобретенных речевых умений в процессе поиска, отбора и использования материала на иностранном языке для написания научной работы (научной статьи, диссертации) и устного представления исследования.

Данная дисциплина предусматривает стартовое владение иностранным языком на одном из уровней – B1, B2, C1.

Программа основывается на следующих концептуальных положениях:

- владение иностранным языком является обязательным компонентом профессиональной подготовки современного специалиста;
- аспирантский курс иностранного языка представляет

собой звено многоэтапной системы «школа – вуз – послевузовское обучение»;

- курс иностранного языка для аспирантов предполагает достижение профессионального делового уровня владения иностранным языком.

По итогам освоения курса обучающиеся должны уметь*:*

- владеть лексическим минимумом до 5500 лексических единиц с учетом вузовского минимума и потенциального словаря, включая примерно 500 терминов по профилирующей специальности;
- владеть грамматикой (морфологическими категориями и синтаксическими единицами и структурами) в объеме, определенном программой, с учетом специфики лексико-грамматического оформления технических документов и научных текстов по технической тематике;
- уметь осуществлять взаимосвязанные виды иноязычной профессионально ориентированной речевой деятельности в области исследования, в том числе:
- *в говорении:* владеть подготовленной, а также неподготовленной монологической речью, делать резюме, сообщения, доклад на иностранном языке; владеть диалогической речью в ситуациях научного, профессионального и бытового общения в пределах изученного языкового материала и в соответствии с избранной специальностью;
- *в аудировании:* понимать на слух оригинальную монологическую и диалогическую речь по специальности, опираясь на изученный языковой материал, фоновые страноведческие и профессиональные знания, навыки языковой и контекстуальной догадки, воспринимать специфику композиционной структуры научного (специального) текста, уметь оценить содержание аудиотекста с точки зрения степени системных связей между фактами и явлениями, аргументированности и важности информации с определенных научных позиций в аспекте научных и профессионально-корпоративных интересов;
- *в чтении:* свободно читать, понимать и использовать в своей научной работе оригинальную научную литературу по специальности, опираясь на изученный языковой материал, фоновые страноведческие и профессиональные знания и навыки языковой и контекстуальной догадки, владеть всеми видами чтения (изучающее, ознакомительное, поисковое и просмотровое);
- *в письме:* владеть письменной речью в пределах изученного языкового материала, в частности уметь составить план

(конспект) прочитанного, изложить содержание прочитанного в форме резюме, подготовить в письменной форме сообщение или доклад по проблематике научного исследования, с четкой композиционной структурой в соответствии с лексико-грамматическими и стилистическими нормами изучаемого языка; уметь составлять документы, отчеты; вести научную переписку; составлять заявку на участие в научной конференции, зарубежной стажировке, получение гранта;

- *в переводе:* уметь оформлять извлеченную из иностранных источников информацию в виде полного и реферативного перевода, резюме в соответствии с нормами и узусом, типологией текстов на языке перевода; уметь осуществлять письменный перевод научного (специального) текста с иностранного на русский язык в пределах, определенных программой; уметь пользоваться словарями, справочниками и другими источниками информации.

В процессе освоения дисциплины у аспирантов (соискателей) развиваются следующие компетенции:

Лингвистическая (или языковая) компетенция предполагает владение системой сведений об изучаемом языке по его уровням: фонетика, лексика, состав слова и словообразование, морфология, синтаксис простого и сложного предложения, основы стилистики текста. Учащийся обладает лингвистической компетенцией, если он имеет представление о системе изучаемого языка и может пользоваться этой системой на практике. На качество языковой компетенции в изучаемом языке влияет не только степень владения им, но и *уровень компетенции аспирантов (соискателей) на родном языке*.

Коммуникативная (или речевая) компетенция предполагает знания речевых ситуаций и умения в области четырех основных видов речевой деятельности (говорения, аудирования, чтения и письма). Коммуникативная компетентность подразумевает умение осуществлять иноязычное общение во всех сферах человеческой деятельности с соблюдением социальных норм речевого поведения. Одно из основных умений, формируемых в рамках коммуникативной компетенции, – это умение продуцировать и воспринимать, понимать иноязычные тексты, устные и письменные.

Научные коммуникативные умения и навыки – это умения и навыки речевого общения, формирование которых возможно только на базе лингвистической или языковой компетенции.

Межкультурная компетенция является важным компонентом современной подготовки аспирантов (соискателей) всех специ-

альностей. Это обусловлено межкультурным аспектом профессиональной деятельности современного специалиста любой области, возникающим как следствие интеграции нашей страны в мировое образовательное, информационное, экономическое пространство и ведущего к реальной практической необходимости эффективно осуществлять межкультурную иноязычную коммуникацию в профессиональной сфере.

MAKING PRESENTATIONS

I. Introduction

The study of speech communication will engage you in one of the oldest academic subjects known "Rhetoric", as the ancient Greeks called it.

Rhetoric – or the art of speaking persuasively – has been one of the most important subjects on the Western European school curriculum from classical times. Classical rhetoric covers all aspects of speaking in public – choice and arrangement of material, style and delivery. In modern usage the term has been somewhat trivialized and is now often used to describe practical skills and strategies that public speakers and presenters use.

Success in many careers depends on good speech communication skills. These include careers in administration, government, public relations, politics, education, sales, and private industry.

Very often in business we find ourselves presenting at conferences and meetings. Some estimates say that over 30 million presentations are given every day. Many of these presentations are given in English by non-native speakers. Many are given badly as presenters often don't know how to go about structuring a presentation or how to use English to maximize effect during a presentation. However, presentations are more important than ever in the present market-oriented climate and are an essential tool for anyone who needs to sell a business proposal, an idea, or even themselves. In business the language is used as a vehicle for the exchange of information and you need to develop certain basic skills to participate successfully in this exchange.

The dictionary definition of presentation is "an event at which a new product or idea is described and explained". It is therefore essential for students looking for employment in business to develop skills, language and techniques needed to present in public with confidence if they wish to succeed in their careers.

Presentations are high-risk, high-visibility activities. Success and failure, can have a significant effect on your career.

The ability to speak English is no guarantee that you can present in English. Presenters need presentation skills and a level of professionalism.

There are many similarities between written and spoken presentations: both are designed to communicate in an ordered way.

But spoken presentations carry additional risks, because speaking to an audience takes place in real time. You cannot try different versions or go back and correct something you do not like. You cannot afford to go blank. And you have an audience there who will let you know if they do not like what you are saying.

The common factors contributing to an unsatisfactory presentation (presentational problems) are the following:

- Content inappropriate to audience (the audience know the content already; the audience don't want to know the content; the content is so muddled that it is impossible to follow)
- Pace inappropriate to difficulty (the speaker goes slowly through the obvious; the speaker rushes through complex arguments; the speaker jumbles his or her notes, and spends most of the time trying to find out where they are);
- Poor delivery (the speaker is inaudible; the speaker's voice is a hypnotic monotone);
- Poor visibility of visual aids (PowerPoint projections are illegible; half the slides are upside down or out of order; the slides are overloading)

The possible list is almost endless, but the above are common faults.

This course is devoted to showing you what is necessary if you are to avoid the risks presentations involve, and make the most of the opportunities that they offer. While it is beyond the scope of this course to turn you into a brilliant speaker, becoming good should be well within your reach. Although bad presentations abound, and you will doubtless have sat through many, the basic principles of effective presentation (presentational strengths) are remarkably simple:

- Clear structure
- Appropriate content
- Interesting delivery
- Good illustrations of points
- Audibility and visibility
- Keeping to time

By following these principles, you should be able to create a professional impression that will serve you well on your course and in your future job.

II. Analyzing your Audience

You should start preparing for your speech by looking at your future audience. Your job is to get as much information about your audience as you can. This information will help you to prepare a speech which is relevant and interesting to your listeners.

Thinking about your audience is the key to good public speaking. If you are preparing a presentation, start with the question: Who are these people? It's the key to success. Whether they are strangers or colleagues, they have one thing in common: they expect you to impress them for the next 15-20 minutes. And the best way to do so is to focus on their favourite subject – themselves. So begin by defining who these people are and what they expect. Here are ten questions to ask yourself.

1. What kind of language do these people use?

If your audience is from a particular industry, what terminology does it understand best? The audience dictates your choice of words, but remember, you should always make your language clear and concise, especially if the language is not your mother tongue.

2. Why were you invited to make this presentation?

Your knowledge of their problems is probably why you were invited to speak. They expect new insights, a different point of view, and ideas that they can take away and use so that they feel their time was well spent listening to you.

3. Can people hear you?

Speak loudly enough to make your voice carry to the furthest listener. No one wants to listen to someone who mumbles and who does not speak with conviction. As a presenter, the ability to pace your speech and use your voice to create impact is the most important skill you need. You will be more effective if you are in control of your voice by your use of stress, pausing, intonation, volume, and silence.

4. How should you look at the audience?

Make direct eye contact. Try convince your audience you are talking to them personally. It also makes you feel that you have made contact with them as individuals. Never talk down (or up) your audience. Treat them as equals, no matter who they are.

5. Should you use notes?

Yes, make an outline, perhaps on small cards, and consult them as you speak. This forces you to organize your presentation in a logical, coherent way and not wander off the points.

6. Are they friends, colleagues, customers or total strangers?

Define who these people are. Define their essential features and motivations.

What work do they do, what is their level of education, what kind of language do they use, what problems and opportunities might they have? Address their goals, their needs, their concerns.

7. Does the audience appreciate humour?

Don't make a special effort to be funny. If you make a joke, don't stop and wait for laughs. What is funny in one culture may not be in another. The subject of your presentation is probably serious and for some people, humour may be out of 94 place. A light touch here and there is all right but humour cannot replace good ideas.

8. Should you use any visual aids?

If they make your speech easier to understand, yes. But make them clear and simple. Don't laboriously read out aloud what is written on your visuals. Make sure that everyone can see them, even from the back of the room.

9. How long should the presentation be?

The best thing is to take only as much time as is necessary. The only thing worse than being long and boring is being too short and not fully understood.

10. What are the audience's feelings and opinions toward the topic of your speech?

For the purpose of persuasive speaking it will be necessary to learn as much as possible about how they feel and why they feel that way in order to do a good job preparing your persuasive speech. You can expect your listeners to feel one of three ways about the topic you choose for your persuasive speech:

a) They Might Agree Completely.

If this is the case, you must choose a different topic for your persuasive speech.

b) They Might Be Indifferent.

Your audience may have the attitude "Who cares?" If this is the case, you must find out why they are indifferent or uninterested in the topic. In your speech you will need to convince them:

1. to be interested in the opinion you are presenting;
2. that it is important to consider;
3. that they should adopt your opinion.

c) They Might Disagree Completely.

They have the opposite opinion from yours or one which is completely different. If this is the case, you must find out their specific reasons for disagreeing with your opinion. In your speech, you will need to convince them that their specific reasons for

disagreeing with the claim you are making are not good reasons. The following Survey of Opinions Form can be used as a guide for audience analysis for the purpose of persuasive speaking.

Survey of Opinions Form

Persuasive Speech Topic: _____

General Audience Reaction to Opinion (Circle one)

Strongly disagree Disagree Indifferent Agree Uninterested Strongly agree

If your audience are indifferent, they are indifferent because: (circle the reasons).

1. They don't think your topic is important.
2. They don't feel your topic affects them.
3. They have never heard of your topic.

If several of your audience disagree with your opinion you will find they probably disagree for different reasons. Ask them their specific reasons for disagreement.

List below.

1. _____
2. _____
3. _____

You must use the results of your Audience Analysis while preparing the main body of your speech. You must present support and evidence which will convince them to agree with you.

In order to persuade listeners with the "who cares" attitude, you must get them interested in your topic. You must prove that your topic is important to think about, or that it directly affects them in some way.

Example: Pretend that your persuasive speech is to convince the audience to buy water purification system for their homes. Listeners are likely to be uninterested in this topic because they don't believe it is important. However, you could tell them that the newspaper ran a story saying that the quality of water in your community is the worst in the country. Expert doctors warn that drinking this water could increase the risk of getting cancer. This type of information would certainly develop interest in your topic and get people to consider your suggestion.

In order to persuade a "hostile" listener (the one who completely disagrees with your opinion or belief), you must know the reasons of disagreeing with you and convince them that their specific reasons for disagreeing are not valid.

III. Presentation Structure

Every public speech (presentation) needs a subject and a purpose. Before you can begin gathering and organizing information for your speech, you must select a topic and clearly understand its purpose. For example, your purpose might be to inform people about an unfamiliar subject, or to persuade them to change their opinion about an issue. The main purpose of speaking to inform is to present information to an audience so that they will understand and remember it.

Your goal in making an informative talk is to state your ideas as simply and as clearly as possible. The major purpose of a persuasive speech is to get others to change their feelings, beliefs, or behavior. Your goal in making a persuasive speech is to convince your listeners to do what you want them to do or to change their opinion about something to agree with your.

Presentations need to be very straightforward and logical. It is important that you avoid complex structures and focus on the need to explain and discuss your work clearly. Think about how you will organize your content. Your presentation should have a clear, coherent structure and cover the points you wish to make in a logical order. Because an audience cannot turn back the page and check what you wrote, it is very easy for them to lose the thread of your spoken argument. Structure is therefore even more important in presentations than it is in written reports, and needs to be emphasized at frequent intervals. The old advice "tell them what you are going to say, say it, and then tell them what you have said" still holds good.

An ideal structure for a presentation includes:

- a welcoming and informative introduction;
- a coherent series of main points presented in a logical sequence;
- a lucid and purposeful conclusion.

It is possible to break these three broad sections down further.

1. Introductory Section

The introduction is the point at which the presenter explains the content and purpose of the presentation. This is vitally

important part of your talk as you will need to gain the audience's interest and confidence. Use the introduction to welcome your audience, explain your objectives, introduce your topic/subject, indicate the main points you will be making and how you will structure these, provide guidelines on questions, say how long you will be talking for.

Key elements of an effective introduction include:

- a positive start: "Good afternoon, my name is …" (who)
- a statement of what will be discussed: "I'm going to explore …" (why)
- a statement of the treatment to be applied to the topic (e.g. to compare, contrast, evaluate, describe): "I'll be comparing the four main principles of…" (what)
- a statement of the outcomes of the presentation: "I hope this will provide us with …" (why)
- a statement of what the audience will need to do (e.g. when they can ask questions or whether or not they will need to take notes): "I'll pass round a handout that summarizes my presentation before taking questions at the end". (how)

Experts in communication say that the first three minutes of a presentation are the most important. They talk about "hooks" – simple techniques for getting, the immediate attention of the audience. Here's how the experts suggest you get the immediate attention of the audience:

1. Give them a problem to think about.
2. Begin your speech with some amazing facts.
3. Begin your speech with a well-known quotation.
4. Address the audience's needs and concerns by telling them what benefits they will gain from listening to you.
5. Ask something and then go on to answer it yourself.

2. Main section (the body of your presentation)

Now that your listeners know exactly what you are going to talk about or what your specific persuasive topic is it is time to present your information or present support and evidence which will convince them to agree with you. Be sure to present the main parts of your speech just the way you said you would. The sequence of your main points should be directly influenced by the purpose of your presentation. Always remember that the aim is to communicate issues in manageable sections or building blocks, helping the audience to piece their understanding together as you work through your material.

After you have identified your main points, you should embellish them with supporting information. For example, add

clarity to your argument through the use of diagrams, illustrate a link between theory and practice, or substantiate your claims with appropriate data. Use the supporting information to add colour and interest to your talk, but avoid detracting from the clarity of your main points by overburdening them with too much detail. Make your presentation easy to comprehend by using sequence words (firstly, finally, etc.) Use them to connect your ideas and give structure to the whole argument.

When presenting orally, you will need to give additional pointers to internal structure within your main body. When you have finished dealing with one point, signal this by a brief summary, of the point just made, and then a short statement of the point you are about to start. You can do this easily and effectively, using simple phrases as "signposts" (transitions or sequencers) to help the audience negative their way through your presentation. They can help divide information up into subsections, 98 link different aspects of your talk and show progression through your topic. Importantly, transitions draw the audience's attention to the process of the presentation as well as the content.

3. Conclusion

The conclusion is an essential though frequently underdeveloped section of a presentation. This is the stage at which you summarize your key points and purpose of your talk, again using visual aids if appropriate, emphasize your recommendations or conclusion, thank your audience, and invite questions. The summary should not be too long as you will lose your audience's attention, but detailed enough to cover your points. A good summary reminds your audience about what you said and helps them to remember your information. After a summary, you are ready to conclude with a statement that will leave your audience thinking about what you said. Never end abruptly or by saying "That's all". The final words of your speech are the ones your audience will remember. Important elements of a conclusion are:

- A review of the topic and purpose of your presentation: 'In this presentation I wanted to explore …."
- A statement of the conclusions or recommendations to be drawn from your work: "I hope to have been able to show that the effect of …"
- An indication of the next stages (what might be done to take this work further?): "This does of course highlight the need for further research in the area of …"
- An instruction as to what happens next (questions,

discussion or group work): "I would now like to give you the opportunity to ask questions …"

- A thank-you to the audience for their attention and participation: "Thank you very much for listening".

The techniques for concluding speeches are the same as those for beginning speeches.

4. Putting your speech together

The question is "which part of a speech do you prepare first?" You should begin with the body of your speech. After the body is prepared, you should write the conclusion, and finally the introduction.

Step one: Preparing the Body of Your Speech.

The body of your speech will contain the outline of the major ideas you want to present. It will also have the evidence or information that supports and clarifies your ideas.

First: List the main headings or subtopics related to your subject.

Write down the main headings which might be included in your speech. Write them as you think of them. Some ideas will be important, some will be insignificant. At this time, just concentrate on writing all the ideas you can think of that relate to the subject and purpose of your speech.

Second: Narrow down your list of main headings.

Review your list of main headings carefully.

Your goal should be to come up with three of four main headings that will develop the subject and purpose of your speech. The bad presentations are where people have tried to give too much information in too much detail and taken too long over it.

Third: Order your main headings logically.

Try to organize your main headings so that each major point leads naturally into the next one. For example, if your speech were entitled "Applying for a Job", you would not talk about the actual interview before discussing the need for a résumé.

A more logical order of main headings might be:

1. Finding the Desired Position
2. Writing a Résumé
3. Scheduling Appointments
4. Behavior During the Personal Interview

Fourth: Develop Your Main Headings.

The main headings are the skeleton upon which your speech will be built. You must develop and support them. If the main headings are properly supported by factual information, logical proof,

and visuals, your audience will understand and remember your speech.

Step Two: Preparing the Conclusion of Your Speech.

When you have finished dealing with the main body, signal clearly that you are now ready to finish your presentation. Make sure you give a clear logical finish making your summary, giving your conclusion and making your closing remarks. Your conclusion section should follow naturally from your main body.

Step Three: Preparing the Introduction to Your Speech.

This is a crucial part of your presentation. It serves as a useful orientation to the reader.

5. Outlining

When you have gathered enough information to prepare the introduction, body and conclusion of your presentation, you are ready to organize it through the use of an outline – that is, a detailed plan of your presentation.

1. The purpose of an outline

1. An outline assures that you have organized your ideas.
2. An outline helps you remember all your information.
3. An outline makes it easy for you to deliver your speech.
4. An outline helps you to stick to the subject of your speech

2. Preparing an outline

When you write an outline, you list very briefly and in the proper order the ideas you wish to include in your presentation. Then, you write the presentation following the outline. If your outline is well arranged, your presentation will be well arranged.

The key to outlining is to identify main topics and break them down into subtopics. A good outline meets three basic requirements:

1. Each idea must relate to and help prove the main point.
2. Each unit of the outline should contain only one idea.
3. Ideas should not be repeated or overlap each other (express the same ideas).

For topic division, use Roman numerals (I, II, III, and so forth). For subdividing a topic, use capital letters, (A,B,C, and so forth, indenting them evenly. If you want to subdivide still more, use Arabic numerals (1,2,3, and so forth) and indent again. For even more subdivision, indent again and use lower-case letters (a,b,c, and so forth). Place a period after each number of letter.

The form for an outline is as follows:

I. _____

A. _____

1. _____

a. _____
b. _____
2. _____
B. _____
1. _____
2. _____
a._____
b. _____
3. _____
II. _____

A.
B.
C.

3. Two different kinds of Outline

There are two kinds of outline: a topic outline and a sentence outline. Topic outline is the most common form of an outline.

The topic and subtopics are noted in brief phrases or single words and are numbered and lettered consistently. No punctuation is needed after the topic in a topic outline.

Sample topic outline.

Managing the Multibusiness corporation
I.The structure of the Multibusiness Company.
A. The theory of the M-Form.
B. Problems of Divisionalized Firms.
II. The role of Corporate management.
III. Managing the Corporate Portfolio
A. Portfolio Planning
1. The GE/Mekinsey Matrix
2. BCG's Growth-Share matrix
B. Value Creation Through Corporate Restructuring.

In a sentence outline, each head or subhead is a complete sentence. Each sentence in a sentence outline must end with a period or a question mark.

4. Sample Outline

The following is a sample outline of an informative speech. It has all the important parts that have been described above.

Stage fright
Introduction

Can you guess what famous dancers, singers, actors, politicians, and executives have in common with us-students in a

speech class? I'll tell you. It's called stage fright.

Preview of what you are going to talk about.

This is something we all have in common. Today we will be learning four major points about stage fright.

First: Some different symptoms of stage fright.

Second: The causes of stage fright.

Third: Famous people who had stage fright.

Fourth: What can be done about it.

Transition to main body: Stage fright affects everyone differently.

Main body of Speech.

I.Symptoms of stage fright.

A: Some people say their heart pounds faster than normal.

B: Others tell how their hands begin to shake.

C: Some people claim that their legs feel week.

Transition: *Although the symptoms of stage fright might vary for all of us, its causes are quite simple.*

II. Reasons for stage fright.

A: Many people worry that they'll forget what they want to say.

B: Others are afraid that they'll look silly.

C: Some people think the audience won't like them.

D: International students might worry that their English isn't very good.

Transition: *You'll be pleased to know that if you get stage fright, you are in a very good company.*

III. Famous people have admitted to stage fright.

A: Winston Churchill once said that he thought there was a block of ice in his stomach each time he made a speech.

B: Julio Iglesias has revealed in interviews that he is nervous about his pronunciation when speaking English.

Transition: *Although you might feel better knowing that even the rich and famous get stage fright, you're probably wondering what can be done about it.*

IV. What can you do about a stage fright?

A: Be thoroughly prepared and practice many times before a presentation.

B: Take your time before you start to speak.

C: Remember that stage fright is normal.

D: Remember that your listeners are your friends, they want you to do well.

Transition to Summary: *I hope you have learnt some new things about stage fright today.*

Summary of what you spoke about

You should now understand four major points about stage fright: its symptoms, its causes, famous people who have had it, and what you can do about it.

Conclusion

The next time you feel nervous about making a speech just tell yourself "I know my stuff and I'll do great!"

IV. Exploiting Visual Aids

If you have a lot of complex information to explain, think about using some charts, diagrams, graphs on an overhead projector or flipchart.

There are some things that can be conveyed far better visually than by words alone. Relationships can be more clearly diagrammed, trends clearly shown via graphs. If your presentation is a lengthy one it is worth varying your aids. You may wish to use a mix of diagrams: some could be on prepared slides, others drawn on a board or flipchart at an appropriate point in your talk. Handouts that you want people to look at while you talk, such as a detailed table that you wish to discuss at length, can usually be distributed as people take their seats. When you give a presentation in a foreign language, visuals are essential for effective communication. It is therefore important for students if they wish to succeed in their careers to develop skills in interpreting information presented in visual aids.

1. Reasons to use Visuals

- Present specific information that can be readily understood and remembered.
- Emphasize important facts and figures.
- Present supporting data that are helpful in making analysis and drawing conclusions.
- Reduce the amount of talking you have to do.
- Add interest to the material.

2. Guidelines about using visual aids to maximum effect.

1. Your visual aids must be large enough for everyone to see.

2. Keep charts, maps and graphs very simple. Don't try to show too many details in one visual aid. Let your visuals speak for themselves. A good visual is like a good newspaper headline-it should make people want to find out more.

3. Do not pass out objects or papers during your speech. If people are looking at objects or reading papers, they will not be listening to what you are saying.

4. When describing very detailed visual aids don't quote precise figures. Give approximate figures and point out the overall trends and developments. Include precise figures and detailed descriptions in a handout or report given out before or after your talk.

5. Look at your audience – not at your visual aids. When you are showing a picture, graph, etc., be sure to maintain eye contact with your listeners.

6. Never compete with your visuals. When showing a visual, keep quiet and give people time to take it in, then make brief comments only.

7. When you've finished using your visual aids, put them away or switch off your projector.

8. If you are giving a presentation with Power Point or something of that nature, make the information on your screen very simple. The rules of presentation are the same all the time. ***Five words per line, five lines per slide, five slides per presentation is the target.***

3. Using PowerPoint

Computers make it remarkably easy to produce impressive overheads, usually using PowerPoint. It offers a number of significant advantages, particularly professional appearance, and flexibility. You can revise your presentation at the last minute, and easily tailor it to a particular audience. You can incorporate relevant tables and graphics. If you are carrying your laptop anyway you do not need to carry anything additional. PowerPoint is a tool you can use to communicate your ideas effectively through visual aids that look professionally designed yet are easy to make. You can produce slides for your presentation and room for notes, at the press of a button print audience handouts, print an outline. These advantages are clear. There are less obvious, but perhaps more serious, hazards with PowerPoint. The ease of generating slides on a computer leads some presenters to use far too many slides so that their audience retains nothing but a blurred impression of an endless series of visuals which they have had no time to absorb. Now that everyone can use PowerPoint, being expert in its use is less impressive than once it might have been. Remember that you are trying to communicate effectively. Be selective and use slides when you need to.

4. Comprehension of Visual presentations

Here we will consider tables and four different kinds of diagram: pie charts, bar charts, Gantt charts and graphs.

a. Tables

A collection of figures can often best be communicated by

means of tables. The table below shows the results of a survey to find out what members of a city sports club think about the club's activities, facilities and opening hours.

Range of activities	Very satisfied	Satisfied	Not satisfied
Female members	35%	35%	30%
Male members	55%	40%	5%
Club facilities			
Female members	64%	22%	14%
Male members	63%	27%	10%
Opening hours			
Female members	72%	25%	3%
Male members	44%	19%	37%

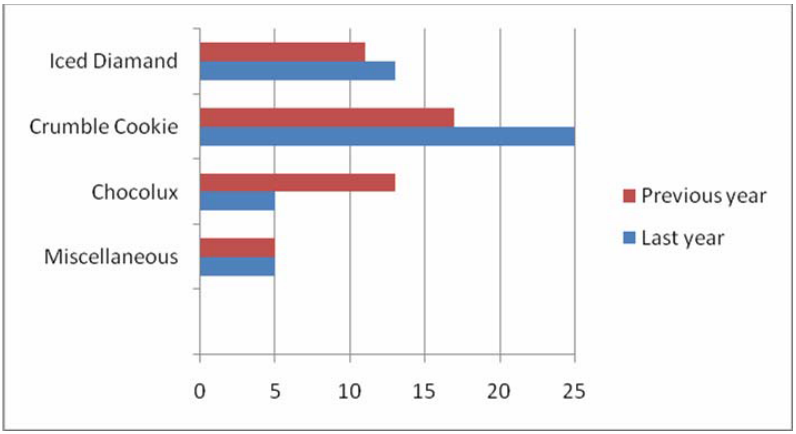
b. Pie charts

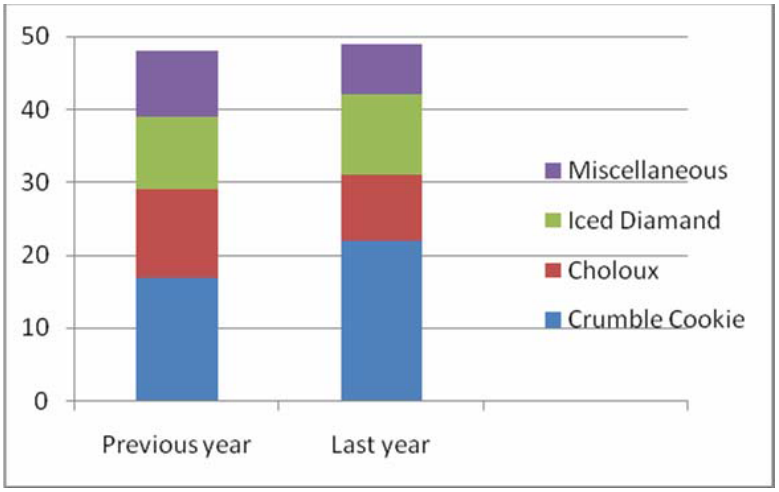
Statistics that are reported in percentages are often presented in what is called a pie chart, in which the complete "pie" represents 100 percent. The distinctions can be heightened by shading or colouring the different segments of the pie. The pie chart shown below indicates the government expenditure (%).

c. Bar charts

Another way of expressing data visually is by means of bar charts. To show data in the form of bar charts, the bar charts are drawn to scale and measured from the base line which may be horizontal or perpendicular. The following bar charts show the sales of the different product lines of the company (Delta Food Products) over the past year.

Horizontal bars





The perpendicular bar chart is also a "composite" bar chart because it includes a breakdown of the individual products in each bar.

d. Gantt charts

A variation of the bar chart is the Gantt chart, used in connection with the process of control in a business. A Gantt chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and

track specific tasks in a project.

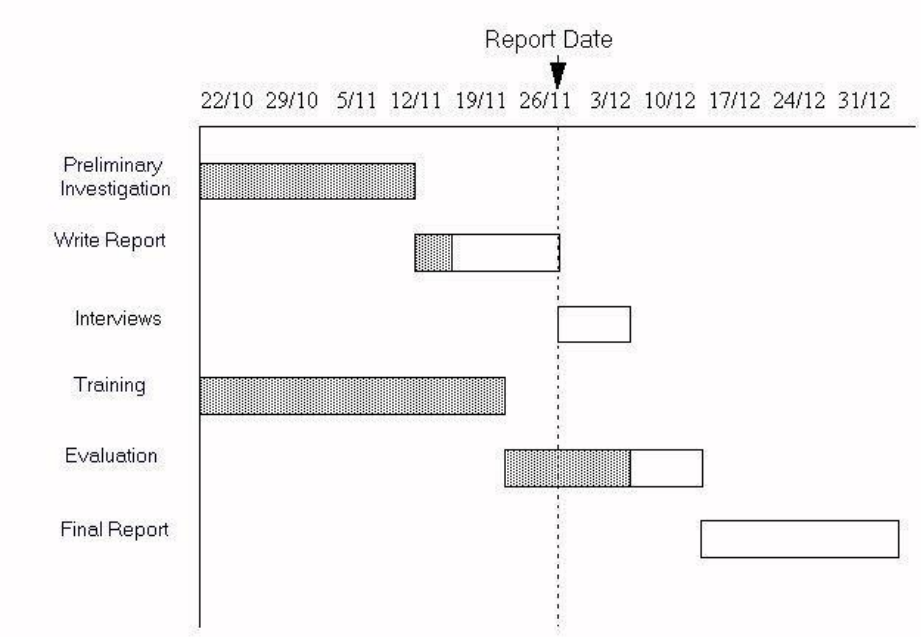
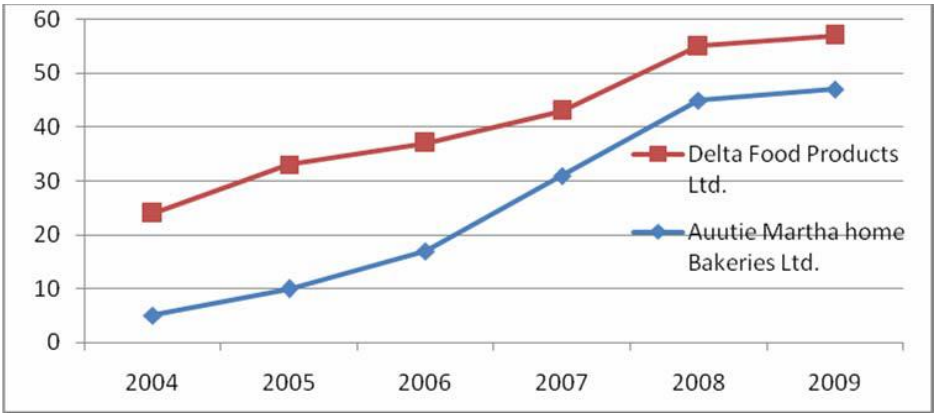


Figure 1: Gantt Chart

Gantt charts may be simple versions created on graph paper or more complex automated versions created using project management applications such as Microsoft Project or Excel.

e. Graphs

The most common form of visual presentation is the graph. Graphs are twodimensional. The x-axis records one dimension, usually the time dimension. The y-axis records another range of data which changes in relation to the time (or other) series. The unbroken line in the graph below shows the sales of Delta Food Products over the past six years. The broken line shows the sales of one of Delta's major competitors.



The benefit of all these diagrammatic representations is that they present the data in an easily assimilable form. Those who are involved in the business need to be able to interpret data presented to them in whatever form.

V. Oral self presentation

A good oral presentation is well structured; this makes it easier for the listener to follow.

Basically there are three parts to a typical presentation: the beginning, the middle and the end or (introduction, body and conclusion). We are going to look at the content of each part individually and the language needed to express its structure and content.

The useful tips and phrases:

The beginning of a presentation is the most important part. It is when you establish a rapport with the audience and when you have its attention.

It is important to greet the audience.

Introduce yourself (name, position, responsibility in the company) Not only to give that important information so people can identify you but also to establish your authority on the subject and to allow the audience to see your point of view on the subject (you are a student, researcher, responsible for, director of, neophyte, layman).

Sometimes, especially when invited to speak, the host introduces the guest, gives the same information as above and then gives the floor to the guest speaker.

Ladies and gentlemen.
Good morning, members of the jury.
Good afternoon, esteemed guests
Good evening, members of the board
Good morning, fellow colleagues
Good morning, Mr. Chairman/ Mrs. Chairwoman
Good afternoon, ladies and gentlemen, let me introduce myself.
Good morning everyone, I'd like to start by introducing myself.
My name is... I am a student at the … where I am a doctoral candidate.
I'm the manager of…
I am a researcher from …
I've been working on the subject now for … years … and I've had wide experience in the field of ...
Good morning, my name is ….
I am a student at the … and I would like to talk to you today about some of my findings in … / the study I did on …
I am very pleased and proud to introduce … who is ….
He/she is known for…
Now I'll turn the floor over to today's speaker. (take the floor, to have the floor, to give the floor to someone.)

Guidelines for Giving an Oral Self Presentation or a Presentation of a Scientific Paper

Practice the talk for an audience and get oral and written feedback. A monotone delivery puts people to sleep. Modulate your voice to show your excitement. Make sure your spoken words provide a logical transition from one slide to the next. Use the title of each slide near the beginning of your spoken text for that slide. Do not memorize your text. Rather, ensure that you know the points you want to make in the order you want to make them. Finally, you may be nervous and thinking of how embarrassed you will be if you don't do a good job. Think instead of serving your audience of making your talk valuable to them by giving them 1-3 points. Think: your audience may be facing talk after talk on unfamiliar subjects, to be received under adverse conditions.

Taking a Post-Graduate Course

Last year by the decision of the Scientific Council I took post-graduate courses to increase my knowledge in economics. I passed three entrance examinations - in History, English and the special subject. So now I am a first year post-graduate student of the

Moscow State University. I'm attached to the Statistics Department. In the course of my post-graduate studies I am to pass candidate examinations in philosophy, English and the special subject. So I attend courses of English and philosophy. I'm sure the knowledge of English will help me in my research.

My research deals with economics. The theme of the dissertation (thesis) is "Computer-Aided Tools for economic analysis". I was interested in the problem when a student so by now I have collected some valuable data for my thesis.

I work in close contact with my research adviser (superviser). He graduated from the Moscow State University 15 years ago and got his doctoral degree at the age of 40. He is the youngest Doctor of Sciences at our University. He has published a great number of research papers in journals not only in this country but also abroad.

He often takes part in the work of scientific conferences and symposia. When I encounter difficulties in my work I always consult my research adviser.

At present I am engaged in collecting the necessary data. I hope it will be a success and I will be through with my work on time.

My research work

I'm an economist in the auditing firm. My special subject is accounting. I combine practical work with scientific research, so I'm a doctoral candidate. I'm doing research in auditing which is now widely accepted in all fields of economy. This branch of knowledge has been rapidly developing in the last two decades. The obtained results have already found wide application in various spheres of national economy. I'm interested in that part of auditing which includes its internal quality control. I have been working at the problem for two years. I got interested in it when a student.

The theme of the dissertation is "Internal quality control of audit services". The subject of my thesis is the development of an effective internal quality control system for audit firm services. I think this problem is very important nowadays as a major portion of public accounting practice is involved with auditing. In making decisions it is necessary for the investors, creditors and other interested parties to know whether the financial statements may be relied on. Hence there should be an internal control of auditing operations for insuring the fairness of presentation.

My work is both of theoretical and practical importance. It is based on the theory developed by my research adviser, professor Ilyinsky. He is the head of the department at the State University. I

always consult him when I encounter difficulties in my research. We often discuss the collected data. These data enable me to define more precisely the theoretical model of the audit internal quality system. I have not completed the experimental part of my thesis yet, but I'm through with the theoretical part.

For the moment I have four scientific papers published. One of them was published in the US journal. I take part in various scientific conferences where I make reports on my subject and participate in scientific discussions and debates.

I'm planning to finish writing the dissertation by the end of the next year and prove it in the Scientific Council of the State University. I hope to get a Ph. D. in Economics.

Writing a CV and a Letter of Application.

Writing a CV/résumé

Before beginning to draft your CV/résumé, read the advert carefully so that you are clear about the specific requirements of the job you're applying for. It's important to tailor both your application letter and the CV/résumé to the job in question, focusing on qualifications and experience that are particularly relevant.

Dos and Don'ts

Here are some general points to bear in mind when preparing your CV/ résumé:

Do

- keep your CV/résumé brief and concise: there is no need to go into a lot of detail about your education or employment history.
- try to keep your CV/résumé to one or two sides of A4 paper.
- use brief, informative sentences, short paragraphs, and standard English.
- when describing your responsibilities and achievements, start each point with an action verb (such as *teaching, leading, developing*): this creates more impact.
- use bold type or bullet points to highlight key information.
- proofread for spelling, grammar, or punctuation mistakes: many employers routinely discard CVs/résumés that contain this type of mistake.
- update your CV/résumé regularly as your situation changes.

Don't

- go into too much detail: employers are too busy to read rambling or unfocused CVs/résumés.

- leave gaps in your employment history: add a sentence or two explaining any periods that are not accounted for.
- use too many different fonts or typefaces: keep to one or two that are clear and easy to read.
- use inappropriate colours, graphics, or photos.
- name people as referees unless you've confirmed that they're happy to provide a reference for you.

Structuring your CV/résumé

A CV/résumé should be clear and well structured, with a limited number of main sections, so that an employer can pinpoint the information they're looking for quickly and easily. Here are some broad guidelines on how to structure an effective CV/résumé.

Personal details

Always begin with your personal details, i.e.:

- name
- address
- telephone number (home and/or mobile)
- email address (personal, rather than work)
- personal profile

There's no need to include your date of birth, your marital status, or your nationality unless the job advert has specifically asked you for this information.

A **personal profile** is a way of introducing yourself to a potential employer. It outlines who you are, what skills and qualities you have, and why you would be an asset to the company. It also provides a good opportunity to tailor your application to the requirements of a job before you move on to the details of your experience or qualifications.

Employment history

Beginning with your current job, if you have one:

- Give a brief outline of your current role, responsibilities, and skills, focusing on those which are most relevant for the job you're applying for.
- Work backwards through other jobs you've held, giving a brief summary of each, highlighting any aspect that's particularly relevant to your application. Include work placements and voluntary work, if applicable.
- Unless you're very young, or you're applying for your first main job, it isn't necessary to list all the less important jobs you may have done. You could summarize them as, for example, 'various temporary administrative posts'.

- Avoid leaving unexplained gaps in your employment history as this can create a negative impression. If you've been bringing up a child, unemployed, or taking a career break, for example, add a sentence explaining this.
- Treat any significant periods of unemployment in a positive way: you could outline any activities you engaged in while you were out of work, such as carrying out voluntary work or learning new skills.

Educational qualifications

- If you're still studying, start by giving this information, making it clear that your studies are ongoing and when the course is due to end.
- If you've completed any other further or higher education, outline this next.
- Then give your secondary school or schools and the dates you attended, together with:

- a list of your A level (or Scottish Higher or equivalent) subjects and grades
- brief details of GCSEs, Scottish Standard Grades, NVQs, or equivalent qualifications (only give full details of these if the employer has specifically asked for them or the subjects are relevant to the job in question)

Any other skills, achievements, or training

- List any relevant courses or training you've completed (e.g. to gain IT skills or knowledge of a foreign language).
- Mention any significant awards you have received or other professional achievements that would be relevant to the job you are applying for.

Interests or pastimes

- A brief outline of your interests and hobbies can help to give a potential employer an insight into the type of person you are. They may also indicate skills you have that you are not using in your current position.

Referees

- Give the names and contact details of people who would be willing to give you a reference. Ideally, one person should be from your current (or most recent) place of work, while the second could be from a previous employer.
- If you're applying for your first job, you could give the

name of a tutor, teacher, or anyone who knows you well enough to vouch for your character (apart from members of your family).

- Always make sure that the people you have in mind are happy to provide a reference for you before you add their names to your CV/résumé.

CV Samples:

Sara Anne Green

Address (college):	26 Windmill Road Bristol, BS2 6DP Telephone (mobile): 0778 6050912
Address (home):	47 Gerrard Street Manchester, M20 4LZ Telephone: 0121 423170
Email:	sara.green@amail.com

A well-organized and outgoing Business Economics student graduating in June 2007 with good communication and analytical skills, looking to develop a career as an economist within an international business environment. Fluent Spanish speaker experienced in the use of spreadsheets, databases, and similar business software.

Education and qualifications:

September 2004 to present:	BA (Hons) in Business Economics City University, Bristol (graduating in June 2007)
September 1996-June 2003	Manchester School 4 A Levels: Economics (A), Information and Communication Technology (A), English (A), Spanish (B) 9 GCSEs (including A* grades in Economics, Spanish, English, Mathematics, ICT, and German)

Employment history:

July-September 2006	**Administrative Assistant**

	MKL Smith & Co (Accountants), Manchester Duties included: • using spreadsheets to sort and chart financial information • administering client database • assisting PA with routine admin tasks
July-September 2005	**English Language Teaching Assistant** EFL International, Seville, Spain Duties included: • assisting teachers in preparing lessons • administering student database • liaising with local companies to organize student activities
July 2003-August 2004	Various jobs (including voluntary and hotel work) and travel in Spain and Latin America, gaining a valuable insight into the culture and spoken language of those countries.
Other qualifications and skills:	Advanced Certificate in MS Word, MS Excel, and MS Access (evening course, September-July 2006) Full driving licence
Interests:	Netball, travel, swimming
References:	Dr Thomas Clark Senior Lecturer in Business and Management Department of Business Organization and Strategy City University Bristol BS1 2ER

Ms Susan Hunter
Senior Partner
MKL Smith & Co
(Accountants)
231 Parker Street
Manchester M20 6QR

CURRICULUM VITAE.

PERSONAL DETAILS Name: Date of birth: Nationality: Address: Telephone	 Mary Brown 25 September 1969 British 52 Hanover Street Edinburgh EH2 5LM Scotland 031 449 0237
EDUCATION 1991-1992: 1988-1991: 1 981-1988:	 London Chamber of Commerce and Industry Diploma in Public Relations University of London BA (Honours) in Journalism and Media Studies (Class II) Fettes College, Edinburgh A-levels in German (A), English (B), History (B) and Geography)

PROFESSIONAL EXPERIENCE 1992 to present: Summers of 1990 and 1991: Summer of 1989:	 Scottish Wildlife Trust Department of Public Relations Responsible for writing articles on all aspects of the Trust's activities and ensuring their distribution to the press. Editor of the Trust's monthly journal. In charge of relations with European environmental agencies. Three-month training period with the Glasgow Herald. Assistant to the sports editor. Sales assistant in the record department of Harris Stores Ltd., Edinburgh	
INTERESTS	Sports: Cross-country skiing, rock-climbing and swimming Secretary of the local branch of «Action», an association organising summer camps for disabled children.	
ADDITIONAL SKILLS	Camp counselling certificate Grade 3 ski instructor Driver's licence (car and motorcycle) IBM PS user Fluent German and good working knowledge of French	
REFERENCES	Geoffery Williams, Professor of Journalism, University of London	Bill Denholm, Sports Editor, Glasgow Herald

The Letter of Application.

The letter of application also called covering letter can be as important as the CV in that it often provides the first direct contact between a candidate and an employer.

If this letter is not well written and presented, it will male a poor impression. The letter of application normally contains three or

more paragraphs in which you should:

- confirm that you wish to apply and say where you learned about the job

I am writing to apply for the position of ... which was advertised last week (when) in The International Herald Tribune (where)

- say why are you interested in the position and relate your interests to those of the company

It has always been my intention to work in ...

I would particularly welcome the chance to work for your company.

The job you are offering matches both my personal and professional interests.

- show what you can contribute to the job by highlighting your most relevant skills and experience

My work experience has familiarised me with ...

I am sure that this, together with my nature experience, would be extremely relevant to the position ...

- indicate your willingness to attend an interview and possibly state when you would be free to attend

I would be pleased to discuss my curriculum vitae with you in more detail at an interview.

Please do not hesitate to contact me if you require further information.

I look forward to hearing from you.

V. Suggestions for Delivering Your Presentations

Your speech is more than just the words you use.

HOW you say something is just as important as WHAT you say.

Good delivery involves several important aspects. The following basic techniques for delivering a speech will help you to improve your own individual style of public speaking.

1. Stage fright: First, let's face one problem about speaking in public which concerns most beginning students-nervousness. Most people are nervous about public speaking. The good news is that you can learn to control your nervousness rather than let it get you down. How will you be able to reduce your nervousness? The best is to be really well prepared. If you know that your topic is interesting, and that your material is well organized, you have already reduced a major worry!

2. Eye contact: You should not look at the floor or out the window because this will give the audience the idea that you are not interested in your topic or in them. The idea is to give the im-

pression that you are talking to each individual in your audience. You will find that if you look directly at your audience, their nods, gestures, and smiles will let you know that they understand you. This positive feedback will make you feel better and less nervous.

3. Speak with enthusiasm: Enthusiasm is being lively and showing your own personal concern for your subject and your audience. If you are truly interested in your topic, your delivery is certain to be enthusiastic and lively.

4. Vary your speaking rate: Your words should not be too fast or too slow. If you speak too slowly you will bore your audience. If you speak too rapidly you will be difficult to understand. Adapt your rate to the context of your speech. For example, if you are explaining complex information, slow down. If you are enthusiastic, you should speed up. This change of pace is very important.

5. Make it easy for people to understand: Speak clearly, without gabbling. Use short sentences and straight forward language. Use the sorts of words and phrases you use for speaking, not those you would use in writing (the large difference between the two explains why it is so difficult to follow a speaker who is reading)

6. Try to be interesting: Use visual aids to sustain interest, and vary your pace. Relevant jokes can be effective if used sparingly. Avoid jokes completely if you have any doubts about your skill in telling them.

7. Use detail sparingly: If detail is important, have a written handout for distribution before or after (not during) your presentation. Handouts distributed during your talk will lose you your audience.

8. Keep any notes brief: It is reassuring to have notes, especially if you are nervous. But keep them brief, and number them clearly so that if you do drop them in your anxiety, or they mysteriously rearrange themselves, you can reorder them easily. Cards are easiest to handle. Mark the point at which you will be using visual aids to what is appropriate. The ease of generating slides on a computer leads some presenters to use far too many slides. There is a risk of giving a very dull presentation, and talking to your computer screen rather than your audience.

9. Avoid over-running the stated time: Not keeping to your allotted time is a sure sign of ineffectiveness. Audiences plan their time, and do not like to have these plans disrupted.

10. Practice: You know now the basic principles of effective delivery and should realize that the actual delivery of your presentation is just as important as having a well-organized and developed speech. However, studying this information won't guarantee an effec-

tive speech presentation. You must rehearse and practice the speech you have prepared. For best results, you should begin practicing days before your actual presentation.

As already suggested (see point 5), you should pay attention to the use of language in your presentation in terms of the clarity of communication. Short words and short sentences will almost certainly make your presentation clearer.

Look at the differences in style between the following two sentences. Note how complicated abstract language can be replaced by simple words so that the message is expressed more clearly.

"In order to improve the performance of employees and ensure that their working practices are as efficient as is humanly possible, a manager needs to make sure that they have adequate and sufficient training to undertake the tasks assigned to them".

The sentence can be rewritten in the following way:

"If employees are to work efficiently, a manager must train them properly".

SCIENTIFIC TALK

More people will probably listen to your scientific talk than will read the paper you may write. Thus the scientific talk has become one of the most important communication forums for the scientific community. As proof, we need only look at the rising attendance at and the proliferation of meetings. In many ways your research reputation will be enhanced or diminished by your scientific talk. The scientific talk, like the scientific paper, is part of the scientific communication process.

The modern scientist must be able to deliver a well organized, well delivered scientific talk. Most scientific presentations use visual aids - and almost all scientific presentations are casual and extemporaneous. This "scientific style" places some additional burdens on the speaker because the speaker must both manipulate visual media, project the aura of being at ease with the material, and still have the presence to answer unanticipated questions. No one would argue with the fact that an unprepared, sloppy talk is a waste of both the speaker's and audience's time. A poorly prepared talk makes a statement that the speaker does not care about the audience and perhaps does not care much about his subject.

Methodology for Preparing an Oral Presentation of a Scientific Paper

Read the paper

Take whatever steps necessary to ensure that you understand its content

List the following

- the problem to be solved
- the method(s) used
- the data
- the interpretation of the data and the assumptions used – the implications/significance

Identify the external constraints on your talk: time, method of presentation

Determine how many slides/overheads you can use

Determine the levels of knowledge of your audience and the levels you want to address them. You could decide to ignore the masses and give a talk only for experts, but this is not recommended.

Given items 4-6 decide on goals for your talk, take home message and what you need to present to accomplish that goal

Prepare a preliminary outline. Each slide should be on a single point.

Write the first draft of text. Each slide should be titled. No full sentences

Figures and tables should be legible, titled, and axes clearly labeled. Use color/formatting to highlight main points as necessary. Make sure that the logic flows and that you have transitions between each slide.

Prepare final text.

II The useful tips and phrases for Preparing an Oral Presentation of a Scientific Paper:

- Situate the subject in time and place, in relation to the audience, the importance. Give a rough idea or a working definition of the subject.
- A cultural aspect may be important here; scientists want to demonstrate their work and findings while managers and humanities people want to share ideas and reflections with their audience. It may be the result of a desire to persuade and convince. It may be comparison of two or more products, plans or proposals.
- It may be very useful to eliminate certain areas before you start so as to avoid confusion or deviation from your main task. It also protects you from criticism later if do not mention it in advance.
- It is useful to give the listeners some idea of the time so as to maintain their attention better.
- You may want to give acknowledgements here too. If you have been sponsored, supported or encouraged by a particular firm, organization, professor, etc. you may want to acknowledge their contribution.
- Concerning grammar the headings of the outline should be of the same grammatical form.
- Your research and paper may have been the work of a collaborative effort and you should acknowledge this too and give the names of all the participants.
- At some point you should ask a question or somehow try to determine where the audience is. You will then have to modify the contents, as you never know exactly what to expect.
- The main purpose of an informative speech is to have the audience understand and remember a certain amount of information.
- You should thus have two purposes: a general purpose and a specific one.
- The former is to inform: to give an overview, to present, to summarize, to outline; to discuss the current situation or to explain how to do something or how something is done.

– You should also let the audience know at some point in the introduction when they may or may not ask questions.

– The latter is what you want the audience to take away with them after listening to you, what you want them to do, what they should remember.

I plan to speak about...
Today I'm going to talk about...
The subject of my presentation is...
The theme of my talk is... I've been asked to talk to you about...
I have chosen to speak about this because...
I was asked to speak about X because...
I will not speak about...
I have limited my speech to
I will speak for 15 minutes
My talk will last about 15 minutes
Have you ever heard of ...?
Every day you encounter…
Have you ever heard of/seen …?
You've probably seen countless times... You may have wondered...
My purpose in doing this paper is to give you a solid background on the subject of oral presentation so that in the future, at the INT or elsewhere you can deliver a successful speech in front of a group.
What I would like to do today is to explain...
to illustrate...
to give a general overview of...
to outline...
to have a look at...
What I want my listeners to get out of my speech is...
I have broken my speech down/up into ... parts.
I have divided my presentation (up) into … parts.
In the first part I give a few basic definitions.
In the next section I will explain …
In part three, I am going to show...
In the last place I would like/want to give a practical example...
I'd ask you to save your questions for the end.
There will be plenty of time at the end of my speech for questions and discussion.
You may interrupt me at any moment to ask questions or make comments.

PUBLIC SPEAKING

Types of Speech

The ability to speak effectively in public is important. Members of groups, companies, or organizations often have to make speeches to large or small groups of people. We give speeches to explain our ideas or plans, to report on the results of research or investigations, to convince people of the advantages of a course of action, or to entertain at a luncheon. Whether we can make a good speech makes a big difference to what other people think about us. Being able to express information and ideas clearly and in a well- organized way in front of a group of people is a useful skill.

There are three types of speeches. One type is an informative speech. In an informative speech, you give information about a certain topic. The second type is a persuasive speech, in which you convince your audience to believe something or to do something. The third type is an entertaining speech. This is the type of speech given at a luncheon, wedding reception, or party.

When you are planning a speech, the first thing you need to do is to make the purpose of the speech clear in your own mind. This is very obvious, but it is sometimes neglected. Are you only giving information about something? Are you trying to persuade your audience of something? Or are you just entertaining your audience? It is useful to write down in a single sentence what you plan to accomplish with your speech. You may or may not actually use this sentence in your speech, but you should keep it in front of you as you work on your speech.

As much as possible, you need to know your audience. How old are they? Are they men or women? What do they already know about the topic? What are their beliefs? Their social and economic backgrounds? Why have they come to listen to you? You should have as much information as possible about your audience, and you should keep it in mind as you prepare your speech. This is called audience analysis. You also need to do research about the topic. You need to collect recent and accurate information. During this process, you will need to collect more information than you will actually need in your speech. The better you know the topic, the more confidently you can speak. As you write your speech, you need to choose appropriate language. Based on the occasion at which you are speaking and on your analysis of the audience, you need to decide how formal the language you use should be, whether you can include technical terms, what sorts of illustrations and data you can use, etc. If the speech is

at a meeting of professional people, you can and should use technical terms, because they will help you get your message across accurately and clearly. However, if your audience is made up of non-professionals who are not likely to be familiar with technical terms, you should avoid them or define them. At an informal speech at a luncheon, you can speak casually and include jokes. You should organize your speech well. You must make the main points clear. At the beginning of each section of the speech, you should specify what you are going to cover in that section, and at the end, you should summarize the section. You need to decide what information should be included and what should be taken out. You need to include good examples, statistics, and quotations to support the points you are making. You need to think about the best order in which to present the information. As you prepare your speech, and later when you deliver it, you need to establish yourself as a credible source. Source credibility is related to whether the source seems believable and trustworthy. Source credibility can be demonstrated in a wide variety of ways. Showing that you are familiar with the topic, showing that you are a trustworthy and concerned person, wearing appropriate clothes, referring to your qualifications to speak about the topic, and speaking in a self-confident and self-assured manner can add to your source credibility.

You should consider using audio-visual aids to make your speech clearer, more interesting, and more effective. You can use charts, maps, overhead projectors, handouts, audio tapes, video tapes, computer graphics, etc., if they help your audience understand your speech better. If you overuse them, or if you use them only for the sake of using them, they will be ineffective and distracting. Your time is usually limited, and using audio-visual aids takes time. Also you have to be well prepared in advance and make sure that they work properly before your speech. After you write the body of your speech, you write the conclusion and then the introduction. The conclusion should summarize the main points and emphasize what you hope to accomplish with your speech. Your audience is likely to remember the points that you make last. Finally, you need to write your introduction. In the introduction, you need to capture the attention of your audience and make the topic and scope of your talk clear. It is useful to put the notes for your speech on cards. Cards allow you more flexibility to adjust your speech to your audience, for example, to skip sections that the audience seems to be already familiar with.

Speech Delivering Process.

Now you have finished writing your speech, but you need to prepare to deliver it. It is necessary to practice in order to be well prepared and to deliver your speech smoothly--though you should not practice so much that your speech sounds stiff. You should probably not memorize every word that you plan to say, but you should practice explaining the main ideas. You do want to be flexible, because you may need to adjust your speech according to your audience's reactions. First you can practice by yourself. Speak at the speed you will use for your speech and time yourself. If you have a large audience, your rate of speaking needs to be slower. You need to make certain that you can finish your speech within the time allowed, but that you do not have too much time left over. Ask a friend to listen to your speech and comment on it. Practice gives you confidence, helps control stage fright, and increases your source credibility by allowing you to sound confident.

The manner in which you deliver the speech is almost as important as the content. As you deliver the speech, you need to speak slowly but fluently and clearly enough that your audience can understand you. Be aware that if you are nervous when you are delivering your speech, you are likely to speak faster than normal. As you are delivering your speech, you will need to make a conscious effort to slow down. You need to speak loudly enough that the entire audience can hear you, but not too loudly. You can use changes in the loudness of your voice to emphasize your important points. You should vary the tone of your voice to help keep your audience's attention. You should stand in a relaxed posture, except in the most formal situations, and your gestures should be natural and support the content of your speech, for example, by using hand gestures to emphasize important points. You should maintain eye contact with members of your audience as you speak, rather than looking at the wall in the back of the room or the floor in front of you. As you speak, it is also important to establish and maintain rapport with your audience. Rapport is a feeling of connection and understanding between the speaker and the audience. As you speak, you need to pay attention to the response of the audience. Do they seem to understand? If not, you may need to slow down, explain a point in a different way, provide an example, etc. Are they getting restless? Maybe you should go on to the next point. Whether your audience gets the information they want from your speech, whether you succeed in convincing them, or whether they are entertained will be influenced by the rapport that you have with them. As it has been pointed out, public speaking is an important and useful skill. Being an

effective public speaker can be rewarding and beneficial in your daily life.

Symposium and Conference

Seminars, workshops, conferences, symposiums etc are events that are held mostly in academic environments. Many people remain confused between these nomenclatures and cannot tell a symposium from a conference considering their similarities and overlapping in the manner in which they are arranged and participated. However, there are differences pertaining to the number of delegates, topics covered, duration of the event.

Symposium

A symposium is a formal gathering in an academic setting where participants are experts in their fields. These experts present or deliver their opinions or viewpoints on a chosen topic of discussion. It would be correct to label a symposium as a small scale conference as the number of delegates is smaller. There are the usual discussions on the chosen topic after the experts have presented their speeches. The chief characteristic of a symposium is that it covers a single topic or subject and all the lectures given by experts are completed in a single day.

Symposium is a bit casual in nature, and there is not much pressure on the delegates to perform or present lectures in the best possible manner as is the case in other academic events. There are lunch breaks, tea, snacks etc to break the ice further.

Conference

Conference refers to a formal meeting where participants exchange their views on various topics. Conference can take place in different fields, and it need not be academic in nature all the time. Thus, we have parent teacher conferences, sport conferences, a trade conference, a conference of journalists, conference of doctors, a conference of research scholars, and so on. A conference is a meeting that has been prearranged and involves consultation and discussion on a number of topics by the delegates.

A conference is on a large scale with a large number of participants though a conference can take place between just two people, the student and his instructor. In general though, a conference refers to a meeting of lots of people coming from different places at the conference venue and discussing their views on a number of topics. A conference stretches over a period of few days with formal discussions taking place on chosen days and according to the agenda of the conference.

Symposium versus Conference

• Conference and symposium are similar events where speakers come together and give their opinions on a chosen subject

• Symposium can be described as a smaller conference that gets over in a single day with a lesser number of delegates

• Symposium is a bit casual in nature with breaks for snacks and lunch

In a symposium, experts give lectures on a single topic whereas in a conference, there is a discussion on several topics.

The Sample of an Informed Consent Form.

Instructions to the Student Researcher:

An informed consent form should be developed in consultation with the Adult Sponsor, Designated Supervisor or Qualified Scientist. This form is used to provide information to the research subject (or parent/guardian) and to document written informed consent, minor assent and/or parental permission.

When written documentation is required, the researcher keeps the original, signed form. Students may use this form or may copy ALL elements of this form into a new document. Please read the following information about the project. If you would like to participate, please sign in the appropriate box below.

Purpose of the project: _____
Time required for participation: _____
Risks: _____
Benefits: _____
Confidentiality: _____
Contact: _____
Adult Sponsor: _____
Phone/email: _____

Voluntary Participation:
Participation in this study is completely voluntary. If you decide not to participate there will not be any negative consequences. Please be aware that if you decide to participate, you may stop participating at any time and you may decide not to answer any specific question.
By signing this form I am attesting that I have read and understand the information above and I freely give my consent/ assent to participate or permission for my child to participate.

Adult Informed Consent or Minor Assent

Printed Name of Research Subject:
Parental/Guardian Permission (if applicable)
Parent/Guardian Printed Name:
Date Reviewed & Signed: Signature:
Date Reviewed & Signed: Signature:

WRITING RESEARCH PAPERS

I. Academic publishing

Scientific literature comprises scientific publications that report original empirical and theoretical work in the natural and social sciences, and within a scientific field is often abbreviated as the literature. Academic publishing is the process of placing the results of one's research into the literature. Original scientific research published for the first time in scientific journals is called the primary literature. Patents and technical reports, for minor research results and engineering and design work, can also be considered primary literature. Secondary sources include review articles which summarize the findings of published studies to highlight advances and new lines of research. They also include books for large projects or broad arguments, including compilations of articles. Tertiary sources might include encyclopedias and similar works intended for broad public consumption.

Academic publishing describes the subfield of publishing which distributes academic research and scholarship. Most academic work is published in journal article, book or thesis form. The part of academic written output that is not formally published but merely printed up or posted on the Internet is often called "grey literature". Most scientific and scholarly journals, and many academic and scholarly books, though not all, are based on some form of peer review or editorial refereeing to qualify texts for publication. Peer review quality and selectivity standards vary greatly from journal to journal, publisher to publisher, and field to field.

Most established academic disciplines have their own journals and other outlets for publication, although many academic journals are somewhat interdisciplinary, and publish work from several distinct fields or subfields. There is also a tendency for existing journals to be divided into specialized sections as the field itself becomes more specialized. Along with the variation in review and publication procedures, the kinds of publications that are accepted as contributions to knowledge or research differ greatly among fields and subfields.

Academic publishing is undergoing major changes, as it makes the transition from the print to the electronic format. Business models are different in the electronic environment. Since the early 1990s, licensing of electronic resources, particularly journals, has been very common. Currently, an important trend, particularly with respect to

scholarly journals, is an open access via the Internet.

There are two main forms of open access: open access publishing, in which a whole journal or book or individual articles are made available free for all on the web by the publisher at the time of publication. Sometimes, but not always, open access is made for an extra publication fee paid by the author or the author's institution or funder. There is also an open access of self-archiving, in which authors themselves make a copy of their published articles available free for all on the web.

There are several types of scientific publications. Scientific literature can include the following kinds of publications:

- scientific articles published in scientific journals
- patents specialized for science and technology (for example, biological patents and chemical patents)
- books wholly written by one or a small number of co-authors
- edited volumes, where each chapter is the responsibility of a different author or set of authors, while the editor is responsible for determining the scope of the project, keeping the work on schedule, and ensuring consistency of style and content
- presentations at academic conferences, especially those organized by learned societies
- government reports such as a forensic investigation conducted by a government agency
- scientific publications on the World Wide Web
- books, technical reports, pamphlets, and working papers issued by individual researchers or research organizations on their own initiative; these are sometimes organised into a series
- blogs and science forums

The significance of these different components of the literature varies between disciplines and has changed over time. Peer-reviewed journal articles remain the predominant publication type, and have the highest prestige. However, journals vary enormously in their prestige and importance, and their status can influence the visibility and impact of the studies they publish. The significance of books, also called research monographs, depends on the subject. Generally books published by university presses are usually considered more prestigious than those published by commercial press. The status of working papers and conference proceedings depends on the discipline; they are typically more important in the applied sciences.

An **abstract** is a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular

subject or discipline. It is often used to help the reader quickly ascertain the paper's purpose. When used, an abstract always appears at the beginning of a manuscript or typescript, acting as the point-of-entry for any given academic paper or patent application. Abstracting and indexing services for various academic disciplines are aimed at compiling a body of literature for that particular subject.

An **article** is a written work published in a print or electronic medium. It may be for the purpose of propagating the news, research results, academic analysis or debate.

The **IMRAD** (/imræd/) structure is the most prominent norm for the structure of a scientific journal article of the original research type. *IMRAD* is an acronym for **i**ntroduction, **m**ethods, **r**esults, **a**nd **d**iscussion. Original research articles are typically structured in this basic order:

1. **Introduction** - Why was the study undertaken? What was the research question, the tested hypothesis or the purpose of the research?
2. **Methods** - When, where, and how was the study done? What materials were used or who was included in the study groups?
3. **Results** - What answer was found to the research question?

   What did the study find? Was the tested hypothesis true?
4. **Discussion** - What might the answer imply and why does it matter? How does it fit in with what other researchers have found? What are the perspectives for future research?

Besides original-research articles, other major types of article include literature reviews, case reports, case series and meta-analyses which usually use non-IMRAD structures.

A **synopsis** is a brief summary of the major points of a subject or written work or story, either as prose or as a table; an abridgment or condensation of a work. The terms **précis** or **synopsis** are used in some publications to refer to the same thing that other publications might call an "abstract". In management reports, an executive summary usually contains more information (and often more sensitive information) than the abstract does.

A **report** or **account** is any informational work (usually of writing, speech, television, or film) made with the specific intention of relaying information or recounting certain events in a widely presentable form. Written reports are documents which present focused, salient content to a specific audience. Reports are often used to display the result of an experiment, investigation, or inquiry. The audience may be public or private, an individual or the public in

general. Reports are used in government, business, education, science, and other fields. Additional elements often used to persuade readers include headings to indicate topics, to more complex formats including charts, tables, figures, pictures, tables of contents, abstracts, and summaries, appendices, footnotes, hyperlinks, and references.

A **thesis** or **dissertation** is a document submitted in support of candidature for an academic degree or professional qualification presenting the author's research and findings. In some contexts, the word "thesis" or a cognate is used for part of a bachelor's or master's course, while "dissertation" is normally applied to a doctorate, while in others, the reverse is true. Dissertations and theses may be considered as grey literature. The word dissertation can at times be used to describe a treatise without relation to obtaining an academic degree. The term thesis is also used to refer to the general claim of an essay or similar work.

A student in Russia has to complete a thesis and then defend it in front of their department. Sometimes the defense meeting is made up of the learning institute's professionals, and sometimes the students peers are allowed to view and/or join in. After the presentation and defense of the thesis, the final conclusion of the department should be that none of them have reservations on the content and quality of the thesis. A conclusion on the thesis has to be approved by the rector of the educational institute. This conclusion of the thesis can be defended or argued not only in the thesis council at, but also in any other thesis council of Russia.

A **monograph** is a specialist work of writing on a single subject or an aspect of a subject, usually by a single author. The term 'monographia' is derived from Greek (**mono**, single+*grapho*, to write), meaning 'writing on a single subject'. Unlike a textbook, which surveys the state of knowledge in a field, the main purpose of a monograph is to present primary research and original scholarship. This research is presented at length, distinguishing a monograph from an article. For these reasons, publication of a monograph is commonly regarded as vital for career progression in many academic disciplines. Intended for other researchers and bought primarily by libraries, monographs are generally published as individual volumes in a short print run. Librarians consider a monograph to be a nonserial publication complete in one volume (book) or a finite number of volumes. Thus it differs from a serial publication such as a magazine, a journal, or a newspaper.

Preparation of an article

The actual day-to-day records of scientific information are kept in research notebooks or logbooks. These are usually kept indefinitely as the basic evidence of the work, and are often kept in duplicate, signed, notarized, and archived. The purpose is to preserve the evidence for scientific priority, and in particular for priority for obtaining patents. They have also been used in scientific disputes. Since the availability of computers, the notebooks in some data-intensive fields have been kept as database records, and appropriate software is commercially available.

The work on a project is typically published as one or more technical reports, or articles. In some fields both are used, with preliminary reports, working papers, or preprints followed by a formal article. Articles are usually prepared at the end of a project, or at the end of components of a particularly large one. In preparing such an article vigorous rules for scientific writing have to be followed.

Structure of a scientific paper

A scientific paper has a standardized structure, which varies only slightly in different subjects. Ultimately, it is not the format that is important, but what lies behind it - the content. However, several key formatting requirements need to be met:

1. The title attracts readers' attention and informs them about the contents of the article. Titles are distinguished into three main types: declarative titles which state the main conclusion, descriptive titles which describe a paper's content, and interrogative titles which challenge readers with a question that is answered in the text. Some journals indicate, in their instructions to authors, the type and length of permitted titles.
2. The names and affiliations of all authors are given. In the wake of some scientific misconduct cases, publishers often require that all co-authors know and agree on the content of the article.
3. A scientific paper summarizes the work in a single paragraph or in several short paragraphs and is intended to represent the article in bibliographic databases and to furnish subject metadata for indexing services.
4. The content should be presented in the context of previous scientific investigations, by citation of relevant documents in the existing literature, usually in a section called an "Introduction".
5. Empirical techniques, laid out in a section usually called "Materials and Methods", should be described in such a way that a subsequent scientist, with appropriate knowledge of and experience in the relevant field, should be able to repeat the observations and know whether he or she has obtained the same result. This naturally varies

between subjects, and does not apply to mathematics and related subjects.

6. Similarly, the results of the investigation, in a section usually called "Results", data should be presented in tabular or graphic form: image, chart, schematic, diagram or drawing. These display elements should be accompanied by a caption and discussed in the text of the article.

7. Interpretation of the meaning of the results is usually addressed in a "Discussion" or "Conclusion" section. The conclusions drawn should be based on the new empirical results while taking into consideration prior knowledge, in such a way that any reader with knowledge of the field can follow the argument and confirm that the conclusions are sound. That is, acceptance of the conclusions must not depend on personal authority, rhetorical skill, or faith.

8. Finally, a "References" or "Literature Cited" section lists the sources cited by the authors in the format required by the journal.

Structure of a Thesis

Author(s) Name(s)
Author Affiliation(s) E-mail
Master'sThesis1
Department of Computer and Systems Sciences Stockholm University and
The Royal Institute of Technology January 2001
Abstract

"The purpose of your thesis is to clearly document an original contribution to knowledge. You may develop computer programs, prototypes, or other tools as a means of proving your points, but remember, the thesis is not about the tool, it is about the contribution to knowledge. Tools such as computer programs are fine and useful products, but you can't get an advanced degree just for the tool. You must use the tool to demonstrate that you have made an original contribution to knowledge; e.g., through its use, or ideas it embodies." (Prof. John W. Chinneck, 2003)

Table of content

1. Introduction

1.1 Background

Start by describing the topic at a general level and finish of with narrowing down the topic to the specific area that the thesis deals with. Basically it is a general introduction to what the thesis is all about.

1.2 Problem

The focus of the thesis, the problem should be of a general nature and a worthwhile problem or a question that has not been previously answered.

1.3 Purpose

Purpose of the thesis and how the problem is addressed. The work has to be an original contribution to knowledge. This could be a new:

Framework or Model
Method
System
Algorithm

1.4 Restrictions

State the restriction made in the thesis. For example the thesis only deals with management in the retail industry.

1.5 Audience

State the audience that the thesis targets. Who would be interested of your work? Your thesis should target researches.
1.6 Methodology
A research methodology defines what the activity of research is, how to proceed, how to measure progress, and what constitutes success.
1.6.1 Preparatory work
1.6.2 Methodology for eliciting the system requirements specification
1.6.3 Methodology for design and implementation
1.6.4 Methodology for data acquisition
1.6.5 Methodology for evaluating the results
2 Extended Background and Basic Concepts
Chapter 2 should include a detailed description of the problem area. The following topics could be included:
Present situation of the problem and the purpose
Other research that is done within the research area / problem area
Presentation of the problem area in general
3 System Requirements Specification
Chapter 3 describes the development of the requirements that are used in order to evaluate if the purpose of the thesis is successfully achieved.
4 Design and Implementation
Chapter 4 describes the design and the implementation of your work if it is applicable. This could for example, be a description of the design and implementation of:
A prototype system
An Algorithm
A Questionnaire
5 Data acquisition
Chapter 5 describes the data acquisition as a part of your thesis.
6 Evaluation
Chapter 6 should summarize your data. The main part of this chapter is to evaluate the degree of fulfillment of your data. By comparing the result with the given requirements in chapter 3 you are able to evaluate your data.

7 Epilogue
7.1 Conclusions
This subsection should include a short and concise statement of the conclusions that you have made because of your work.

How the problem stated in the thesis has been solved and shown in the thesis. Refer to the previous chapters in the thesis.
Summarize the results.
7.2 Discussion
Discussion subsection includes the author's opinions
There is no need to prove your opinions in this subsection
There should be a logical reasoning
7.3 Future Work
Describe future work that can be done by yourself or other researches. Basically are there any new problem statements that originate from your work?
8 References

II. Titles

What key skills are needed when writing a Title?

Browsers on the Internet looking for a paper may read hundreds of titles before they select an Abstract to read. According to one of Britain's top editors, writing good headlines represents about 50% of the skills vital to article writing. For this reason the gurus of research writing tend to dedicate more pages to discussing the importance of the title than they do to any section in the paper itself.

Every word in your title is important. So the key is to devise a title that:

1 will immediately make sense to the referee

2 will easily be found by a search engine or indexing system

3 will attract the right kind of readers rather than discouraging them, and will also catch the attention of browsers. Note 'attraction' does not mean resorting to newspaper-like headlines, but simply containing those words that readers in your field would expect to find

4 does not consist of a string of nouns and will be immediately comprehensible to anyone in your general field

5 is short

6 has a definite and concise indication of what it is written in the paper itself. It is neither unjustifiably specific nor too vague or generic

How can I generate a title?

Think about the following questions:

• What have I found that will attract attention?

• What is new, different and interesting about my findings?

• What are the 3–5 key words that highlight what makes my research and my findings unique?

On the basis of your answers you should be able to for-

mulate a title.

What types of words should I try to include?

Where possible use the *-ing* form of verbs rather than abstract nouns. This will make your title more readable as well as making it 2–3 words shorter.

ABSTRACT NOUNS	VERBS
The *Specification* and the *Evaluation* of Educational Software in Primary Schools	*Specifying* and *Evaluating* Educational Software in Primary Schools
Methods for the *Comparison* of Indian and British Governmental Systems in the 19th century	Methods for *Comparing* Indian and British Governmental Systems in the 19th century
A Natural Language for Problem *Solution* in Cross Cultural Communication	A Natural Language for *Solving* Problems in Cross Cultural Communication
Silicon Wafer Mechanical Strength *Measurement* for Surface Damage *Quantification*	*Quantifying* Surface Damage by *Measuring* the Mechanical Strength of Silicon Wafers

The key words in your title are likely to be nouns. So choose these nouns very carefully. The key words in the first title above are *educational software* and *primary schools*.

Try to choose adjectives that indicate the unique features of your work, e.g. *low cost, scalable, robust, powerful*. Adjectives such as *reliable* should only be used if work in your field has so far only produced an unreliable system or unreliable results.

How can I assess the quality of my title?

- You need to check that your title is:

° in correct English - in terms of syntax, vocabulary, spelling and capitalization

° understandable (no strings of nouns)

° eye-catching and dynamic (through effective use of vocabulary and even punctuation)

° sufficiently and appropriately specific

° reflects the content of your paper

° expressed in a form that is acceptable for a journal

-You can check the syntax and the level of understandability by consulting with a native speaker. Generally speaking titles that contain at least one verb and one or more prepositions tend to be much easier to understand.

You can check the vocabulary and spelling using Google Scholar. Remember that an automatic spell check is not enough.

- The best way to decide whether it is eye-catching and sufficiently specific is to prepare several titles (including ones in two parts, and in the form of a question) with various levels of specificity and ask colleagues to choose their favorite.

- Unless you get someone to read the whole paper for you, you are probably the best judge of whether your title reflects the actual content of your paper. If it doesn't, the referees will probably tell you.

III. Abstracts

What is an abstract? How long should it be?

There are four main types of abstracts, all of which summarize the highlights of your research and all of which will be judged in isolation from the accompanying paper (if there is one). Abstracts are sometimes called Summaries.

Abstracts are found before a full article in a journal, standalone in databases of abstracts, and in conference programs.

UNSTRUCTURED ABSTRACT

A single paragraph of between 100–250 words containing a very brief summary of each of the main sections of your paper

STRUCTURED ABSTRACT

The same as (1) but divided into several short sections.

EXTENDED ABSTRACT

A mini paper organized in the same way as a full paper (e.g. Introduction, Methods, Discussion…), but substantially shorter (two to four pages). Depending on the journal, conference or competition, the extended abstract may or may not include an abstract – for example, it may begin directly with an introduction

CONFERENCE ABSTRACT

Normally a standalone abstract (sometimes up to 500 words), designed to help conference organizers to decide whether they would like you to make an oral presentation at their conference. It may be of any of the three forms above. The type of abstract you choose and the format to use will depend on the journal or conference. Make sure you read their instructions to authors before you begin writing.

When should I write the Abstract?

Write a rough draft of the abstract before you start writing

the paper itself. This may help you to decide what to include in the paper and how to structure it. But experienced writers always write the Abstract (and often the Introduction too) last, i.e. when they have finished the rest of the paper. This reflects the research process itself – the first thing you write about is what you found, then how this can be interpreted.

In any case, and as with the whole paper, you must have a clear idea of your intended audience.

How should I structure my Abstract?

An Abstract generally answers at least the first three of the following questions, and generally in the following order. You can use the answers to these questions to structure your Abstract.

- Why did I carry out this project? Why am I writing this paper?
- What did I do, and how?
- What were my results? What was new compared to previous research?
- What are the implications of my findings? What are my conclusions and/or recommendations?

However chemists, physicists, biologists etc. who are presenting some new instrumentation may want to focus not on what they found, but on what the benefits of their apparatus are and how well it performs.

To decide what to include it may help you to go through your paper and highlight what you consider to be the most important points in each section.

What style should I use: personal or impersonal?

There are four possible styles for writing abstracts and papers:

STYLE 1	I found that x = y.
STYLE 2	We found that x = y.
STYLE 3	It was found that x = y.
STYLE 4	The authors found that x = y.

The style you use will depend on your discipline and on the requirements of the journal. Using the first person singular (Style 1), is generally only found in humanistic fields where the author's opinions are often outlined. Here is an example – an abstract from a paper entitled *International scientific English: Some thoughts on science, language and ownership.*

STYLE 1 The intention of this paper is to raise some questions about the 'ownership' of scientific English. Its author is a native speaker of English and a teacher of scientific English, but it aims its

arguments at the international scientific community communicating in English. The paper is deliberately somewhat provocative in parts in an attempt to raise some questions about 'scientific English' which *I think* are important but which have not been faced to date.

Style 2 is found in all fields. Here is an example of the beginning of an abstract from a physics paper entitled *Tumbling toast, Murphy's Law and the fundamental constants*.

STYLE 2 *We investigate* the dynamics of toast tumbling from a table to the floor. Popular opinion is that the final state is usually butter-side down, and constitutes prima facie evidence of Murphy's Law ('If it can go wrong, it will'). The orthodox view, in contrast, is that the phenomenon is essentially random, with a 50 / 50 split of possible outcomes. *We show* that toast does indeed have an inherent tendency to land butter-side down for a wide range of conditions.

[to tumble = to fall and turn; butter-side down = people in Britain often put butter on one side of their toast]

Style 3 is also very common and many journals insist on this style. An example of this style is an abstract from a fictitious paper entitled *Is it Time to Leave Him?* Written by one of my PhD students, Estrella Garcia Gonzalez from Madrid. By *sittingzapping sessions* she means sitting like a zombie in front of the television and constantly changing channels.

STYLE 3 Three red flags were identified that indicate that the time to leave him has come. These red flags are: five burps per day, two sitting-zapping sessions per day, and fives games on the Playstation with friends per week. A large number of women have doubts about the right moment for leaving their partner. Often women wait in hope for a change in their partner's habits. One hundred couples were analyzed, recording their daily life for six months. Women were provided with a form to mark the moments of annoyance recorded during the day. Burps, sitting-zapping sessions and games on the Playstation with friends produced the highest index of annoyance. The probability of eliminating these habits was found to be significantly low when the three red flags had been operative for more than three months. Thus, these numbers provide a good indication of when the time to leave him has come. With these red flags, women will no longer have to waste their time waiting for the right moment.

Style 4 is the least common style. Here is an example of the beginning of an abstract from a fascinating psychology paper entitled *Unskilled and unaware of it:*

How difficulties in recognizing one's own incompetence lead to inflated selfassessments

STYLE 4 People tend to hold overly favorable views of their abilities in many social and intellectual domains. *The authors* suggest that this overestimation occurs, in part, because people who are unskilled in these domains suffer a dual burden: Not only do these people reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the metacognitive ability to realize it. Across 4 studies, the authors found that …

How can I assess the quality of my Abstract?

To make a self-assessment of your Abstract, you can ask yourself the following questions.

- Have I followed the journal's instructions to authors? Have I followed the right structure (i.e. structured, unstructured) and style (*we* vs passive)?
- Have I covered the relevant points from those below?
° background / context
° research problem / aim - the gap I plan to fill
° methods
° results
° implications and/or conclusions
- Have I chosen my keywords carefully so that readers can locate my Abstract?
- Whenever I have given my readers information, will it be 100% clear to them why they are being given this information? (You know why, but they don't.)
- Can I make my Abstract less redundant? If I tried to reduce it by 25% would
I really lose any key content?
- Have I used tenses correctly? present simple (established knowledge), present perfect (past to present background information), past simple (my contribution)

Exercise: Write an Abstract related to your current research, alternatively invent some research. Choose one of the two possible structures below.

STRUCTURE 1

1. Give a basic introduction to your research area, which can be understood by researchers in any discipline. (1–2 sentences).
2. Provide more detailed background for researchers in your field. (1–2).
3. Clearly state your main result. (1 sentence).
4. Explain what your main result reveals and / or adds when compared to the current literature. (2–3 sentences).
5. Put your results into a more general context and explain the

implications. (1–2 sentences).

STRUCTURE 2

1. Begin by saying what you did plus introduce one key result, i.e. begin with information that the reader does NOT already know. (1–2 sentences).

2. Introduce the background by connecting in some way to what you said in your introductory sentence / s. (1 sentence).

3. Use the background information (which the reader may or may not already know) to justify what you did, and outline your methodology (and materials where appropriate). (1–2 sentences).

4. Provide some more information regarding your results. (1–2 sentences).

5. Tell the reader the implications of your results. (1–2 sentences).

IV. Conclusions

How should I structure the Conclusions?

The Conclusions section is not just a summary. Don't merely repeat what you said in the Abstract and Introduction. It is generally not more than one or two paragraphs long. A Conclusions section typically incorporates one or more of the following:

1. a very brief revisit of the most important findings pointing out how these advance your field from the present state of knowledge

2. a final judgment on the importance and significance those findings in term of their implications and impact, along with possible applications to other areas

3. an indication of the limitations of your study (though the Discussion may be a more appropriate place to do this)

4. suggestions for improvements (perhaps in relation to the limitations)

5. recommendations for future work (either for the author, and/or the community)

6. recommendations for policy changes

The order these items appear is likely to be the same as suggested above.

It differs from the Abstract and Introduction as it is for a more informed reader. In fact, you are making a summary for readers who hopefully have read the rest of the paper, and thus should already have a strong sense of your key concepts. Unlike the Abstract and Conclusions it:

- does not provide background details
- gives more emphasis to the findings (point 2)

• talks about limitations, which are not normally mentioned outside the Discussion and Conclusions (point 3)

• covers three additional aspects (points 4–6)

How can I assess the quality of my Conclusions?

To make a self-assessment of your Conclusions, you can ask yourself the following questions.

- Is what I have written really a Conclusions section? (If it is more than 200–250 words, then it probably isn't – it needs to be much shorter)

- If the conclusions are included in the Discussion, have I clearly signaled to the reader that I am about to discuss my conclusions (e.g. by writing *In conclusion …*)?

- Have I given a maximum of one line to comments related to descriptions of procedures, methodology, interviews etc.? (Generally such comments are not needed at all, unless the primary topic of your paper is the methodology itself)

- Have I avoided cut and pastes from earlier sections? Do my Conclusions differ appropriately from my Abstract, Introduction and final paragraph of my Discussion?

- Are my Conclusions interesting and relevant?

- Have I given my Conclusions as much impact as possible and have I avoided any redundant expressions?

- Have I avoided any unqualified statements and conclusions that are not completely supported?

- Is my work as complete as I say it is? (i.e. I am not trying to get priority over other authors by claiming inferences that cannot really be drawn at this stage)

- Have I introduced new avenues of potential study or explained the potential impact of my conclusions? Have I ensured that I have only briefly described these future avenues rather than getting lost in detail?

- Are the possible applications I have suggested really feasible? Are my recommendations appropriate?

- Have I used tenses correctly? present perfect (to describe what you have done during the writing process), past simple (what you did in the lab, in the field, in your surveys etc.)

Exercise 1: The texts below describe a study by a researcher investigating when would be the optimum time for a female student to terminate her love relationship with her male partner. Compare the Abstract and Conclusions below, by answering these questions.

1. What information is given in the Abstract that is also given in the Conclusions?

2. What information is exclusive to the Conclusions?

3. How does the author use the current research in China to summarize the methods used in her South American research?

ABSTRACT Three red flags were identified that indicate that the time to leave him has come. These red flags are: five burps per day, two channelzapping sessions per day, and fives games on the Playstation with friends per week. Many women have doubts about the right moment for leaving their partner. Often women wait in hope for a change in their partner's habits. One hundred couples (above all South American) were analyzed, recording their daily life for six months. Women were provided with a form to mark the moments of annoyance recorded during the day. Burps, channel-zapping sessions and games on the Playstation with friends produced the highest index of annoyance. The probability of eliminating these habits was found to significantly low when the three red flags had been operative for more than three months. Thus, these numbers provide a good indication of when the time to leave him has come. With these red flags, women will no longer have to waste their time waiting for the right moment.

CONCLUSIONS The three red flags identified in our research – numbers of burps, zapping sessions, and Playstation sessions – should enable women to understand when they need to leave their partner. To counter any effects due to the nationality of the women involved (predominantly South American in our sample), we are currently doing tests in China. The results we have so far for China would seem to con firm our initial findings, but with an additional fourth flag: time spent studying for examinations. In addition, the timeframe for the flags to be operative in China is two months, rather than the three months reported in this paper. We also plan to replicate our tests on a wider range of women and a longer time scale, thus increasing the sample base from 100 to 1,000, and increasing the recording of daily life annoyances from six months to twelve months. Future research could be dedicated to doing analogous tests to enable men to see the signs of when they should leave their woman, and for employees to identify when they should leave their current employment.

V. Useful Phrases

1. Establishing why your topic (X) is important

X is the main / leading / primary / major *cause of* ..

Xs are a common / useful / critical *part of*…

Xs are among the most widely used / commonly discussed / well-known / well-documented / widespread / commonly investigated *types of* …

X is recognized as being / believed to be / widely considered to be *the most important* …

It is well known / generally accepted / common knowledge *that X is* …

X is increasingly becoming / set to become *a vital factor in …*

Xs are undergoing a revolution / generating considerable interest *in terms of* …

Xs are attracting considerable / increasing / widespread *interest due to* …

X has many uses / roles / applications *in the field of* …

A striking / useful / remarkable *feature of* …

The main / principal / fundamental *characteristics of X are:*

X accounts / is responsible *for*

2. Stating the aim of your paper and its contribution

In this report / paper / review / study *we* …

This paper outlines / proposes / describes / presents *a new approach to* …

This paper examines / seeks to address / focuses on / discusses / investigates *how to solve* …

This paper is an overview of / a review of / a report on / a preliminary attempt to …

The present paper aims to validate / call into question / refute *Peng's findings regarding* …

X is presented / described / analyzed / computed / investigated / examined / introduced / discussed *in order to* …

The aim of our work / research / study / analysis *was to* further / extend / widen / broaden *current knowledge of* …

Our knowledge of X is largely based on very limited data. The aim of the research was thus / therefore / consequently *to*

The aim of this study is to study / evaluate / validate / determine / examine / analyze / calculate/ estimate / formulate …

This paper calls into question / takes a new look at / re-examines / revisits / sheds new light on …

With this in mind / Within the framework of these criteria / In this context *we tried to* …

We undertook this study / initiated this research / developed this methodology *to* …

We believe that we have found / developed / discovered / designed *an innovative solution to* …

We describe / present / consider / analyze *a* novel / simple / radical / interesting *solution for* …

3. Giving the structure of paper - what is and is not included

This paper is organized as follows / divided into five sections.
The first section / Section 1 *gives a brief overview of* …
The second section examines / analyses …
In the third section a case study is presented / analyzed …
A new methodology is described / outlined *in the fourth section* …
We / I *propose a new procedure in Section 4*.
Some / Our *conclusions are drawn in the final section*.
This paper / chapter / section / subsection *begins by examining* …
The next chapter looks at / examines / investigates *the question of* …
Problems / Questions / Issues *regarding X are discussed in later sections*.
A discussion of Y is / falls outside *the scope of this paper*.
For reasons of space, Y is not addressed / dealt with / considered *in this paper*.
4. Describing purpose of testing / methods used
In order to identify / understand / investigate / study / analyze *X …*
To enable / allow *us to … , we …*
To see / determine / check / verify / determine *whether* …
To control / test *for X, Y was done*.
So that we could / would be able to *do X, we …*
In an attempt / effort *to do X, we …*
X was done / We did X *in order to* …
5. Highlighting significant results and achievements
The most striking / remarkable *result to emerge from the data is that* …
Interestingly / Curiously / Remarkably / Inexplicably, *this correlation is related to ….*
Significantly / Importantly / Crucially / Critically, *X is …*
The correlation between X and Y is interesting / of interest / worth noting / noteworthy / worth mentioning *because* …
The most surprising / remarkable / intriguing *correlation is with the* …
The single most striking / conspicuous / marked *observation to emerge from the data comparison was …*
It is interesting / critical / crucial / important / fundamental *to note that …*
We believe that / As far as we know / As far as we aware *this is the first time that X* …

We believe that / We are of the opinion that / In our view *the result emphasizes the validity of our model.*

This result has further strengthened our confidence in X / conviction that X is / hypothesis that X is …

Our technique shows a clear / clearly has an *advantage over* …

The importance of X cannot be stressed / emphasized *too much*.

This underlines / highlights / stresses / proves / demonstrates *just how important X is*.

The utility of X is thus underlined / highlighted / stressed / proved / demonstrated.

This finding confirms / points to / highlights / reinforces / validates *the usefulness of X as a …*

Our study provides additional support for / further evidence for / considerable insight into *X*.

These results extend / further / widen *our knowledge of X*.

These results offer compelling / indisputable / crucial / overwhelming / powerful / invaluable/ unprecedented / unique / vital *evidence for …*

6. Announcing your conclusions and summarizing content

In conclusion / In summary / In sum / To sum up, *our work* …

Our work has led us to conclude / the conclusion *that* …

We have *presented / outlined / described* …

In this *paper / study / review* we have …

This paper has *investigated / explained / given an account of* …

7. Restating the results (Conclusions section)

The evidence from this study suggests / implies / points towards the idea / intimates *that* …

The results / findings *of this study* indicate / support the idea / suggest *that* …

In general, / Taken together, *these results* suggest / would seem to suggest *that* …

An implication / A consequence / The upshot *of this is the possibility that* …

8. Highlighting achievements (Conclusions section)

Our research / This paper *has* highlighted / stressed / underlined *the importance of …*

We have managed to do / succeeded in doing / been able to do / found a way to do *X.*

We have found an innovative / a new / a novel / a cutting-edge *solution for …*

We have obtained accurate / satisfactory / comprehensive *re-*

sults proving / demonstrating / showing *that* …

We have devised a methodology / procedure / strategy *which* …

We have confirmed / provided further evidence / demonstrated *that* …

Considerable progress has been made / insight has been gained *with regard to*

Taken together, these findings suggest / implicate / highlight *a role for X*

Our study provides the framework / a springboard / the backbone / the basis / a blueprint / an agenda / a stimulus / encouragement *for a new way to do X*.

The strength / strong point / value / impact / benefit / usefulness / significance / importance *of our* work / study / contribution *lies in …*

X provides a powerful tool / methodology *for* …

X ensures / guarantees *that X will do Y, and it can be generalized to …*

Our investigations into this area are still ongoing / in progress *and seem likely to confirm our hypothesis.*

These findings add to a growing body of literature on / substantially to our understanding of *X*.

9. Referring to tables and figures, and to their implications

Table 1 compares / lists / details / summarizes *the data on X.*

Table 2 proves / shows / demonstrates / illustrates / highlights *that X is* …

Figure 1 presents / reports / shows / details *the data on X*.

Figure 3 pinpoints / indicates *exactly where X meets Y*.

As shown / highlighted / illustrated / detailed / can be seen *in Fig. 1, the value of* …

The value of X is greater when Y = 2 (Fig. 1 / Eq. 2)

The results on X can be seen / are compared / are presented *in Fig. 1*.

From the graph / photo / chart / histogram *we can* see / note *that* …

It can be seen in / is apparent from *Fig. 1 that* …

We observe / note *from Table 1 that* ..

The graph above / below / to the left / to the right *shows that …*

Figure 8 shows a clear trend / significant difference *in* …

The table is revealing / interesting *in several ways. First …*

10. Referring back to your research aim

As stated in the Introduction, our main aim / objective / target / purpose / goal *was to …*

As stated in the Introduction, the research was conducted / undertaken / carried out *in order to …*

Given that / Since *our main aim was, as mentioned in the Introduction, to …*

Before interpreting our results, we remind the reader of / would just like to restate *our main aims*.

Returning to the hypothesis / question *posed at the beginning of this study, it is now possible to state that …*

RENDERING

What is rendering?

Imagine you work in an office. Imagine one morning your boss comes up to your desk with a file of papers and says: «I want you to read this up, represent it in a smaller volume, suppressing all insignificant information, and give your own conclusion». He/she won't be saying like that, actually. He/she will say «Render this, please». Rendering is defined in the Webster's dictionary as «art of making presentations». Art indeed, as it requires a lot of your skills and knowledge of reconstructing and rearranging a written passage without any considerable damage to its context and idea(s).

You may have to prepare rendering for two main purposes:

- one can read your rendering and won't have to take up the original passage.
- one can read your rendering and decide for themselves if they need to take up the original passage or not.

Rendering can't be produced without thorough comprehension of the passage. Dividing the text into logical parts and singling out the main idea of each of them can be an essential help in understanding the passage. You will have to read the original more than once.

All methods of rendering are based on the notional compression of the text, which presupposes the elimination of all types of redundancy, i.e. elements that repeat each other.

A rendering is a text based on the notional compression of the original with the aim of rendering its general matter. The material in a rendering is presented from the point of view of the author of the original and does not include any elements of interpretation or evaluation. Rendering can be performed with two aims: informative and educational. Since the objective of this textbook is to provide you with tools for oral rendering in the framework of Conversation Practice lessons, you will still be asked to give your opinion of the original text at the end of your rendering.

A **rendering** is usually kept to the following structure:

- introduction, where you provide all necessary background information such as the title and source of the passage and state the main idea;
- the body, where the main idea is revealed;
- the conclusion on the passage;
- your opinion of the problem (position) introduced in the passage.

There are several basic principles you are to follow in order to

make a successful rendering:

- You have to develop your power of judgment, so that you may be able to decide rightly what must be expressed and what must be suppressed;
- In rendering, facts should be expressed as plain statements, with constant reference to the author of the passage. Try to avoid evaluative words and phrases in the body of the rendering, keep them for expressing your own opinion;
- Figurative language is in most cases unsuitable.

The Plan of Rendering Newspaper Article

1. The headline of the article is ... (The article is headlined ..., The headline of the article I've read is...)
2. The author of the article is...
3. The article is taken from the newspaper...
4. The central idea of the article is about... (The main idea of the article is... the article is devoted to... the article deals with... the article touches upon... the purpose of the article is to give the reader some information on... the aim of the article is to provide a reader with some material on...)
5. Give a summary of the article (no more than 10-20 sentences).
6. State the main problem discussed in the article and mark off the passages of the article that seem important to you.
7. Look for minor peculiarities of the article.
8. Point out the facts that turned out to be new for you.
9. Look through the text for figures, which are important for general understanding.
10. State what places of the article contradict your former views.
11. State the questions, which remained unanswered in the article and if it is possible add your tail to them.
12. Speak on the conclusion the author comes to.
13. Express your own point of view on the problem discussed.

Remember some useful expressions that will help you to render the newspaper article

The author starts by telling the reader about...
According to the text...
The author stresses...
Further the author reports that...
To all appearances...
I want to single out the key points on which the article is based.

In conclusion I want to add...

Let's look through the text for figures, dates (or data) which are very important for the general understanding the problem discussed.

I want to point out the following facts that turned out to be new for me.

The central idea can be worded in the following way.

Then I'm going to state the main problem discussed in the article.

The most widespread opinion is...

It's extremely hard to predict...

Needless to say that...

As far as can be judged from the press...

Different sources say that...

The article contains a lot of key, important words (terms).

The article is pretty-packed, expressive, and very emotional; contains (very) important facts.

The essence of news is...

to have one's fingers on the pulse of current events, public opinion;

to appeal to a wide readership;

news of general interest

The article expresses (doesn't express) the opinion of the author; it just states the facts.

The information is very actual and important not only for... but for... (average men).

As for me, I'm sure that...

The article is headlined…

The author of the article is…

It was published in…

The article is concerned with …

The article deals with…

The subject of the article is…

At the beginning of the article the author describes…

To depict, to dwell (up)on, to touch (up)on, to explain, to introduce, to mention, to recall, to characterize, to analyze, to comment on, to enumerate, to point out, to emphasize, to stress, to underline, to generalize about, to criticize, to make a few critical remarks on, to reveal, to expose, to accuse, to blame, to condemn, to mock smth, to ridicule, to praise, to give a summary of, to give one's account of… The article (the author) begins with a (the) description of…

By mentioning, the analysis of, the summary of, a comment on,

a review of, an account, characterization of, one's opinion of/about, one's recollection of, some (a few) critical remarks about (of, concerning…), the accusation of, the generalization of…

The article opens with…

Then (after that, further on, next) the author passes on to, goes on to say that, gives a detailed (thorough) analysis (description)…

In conclusion the author…

The article ends with…

At the end of the article the author draws the conclusion that…

We find the conclusion that…

To finish the article the author describes…

At the end of the article the author sums it all up (by saying…)…

The article I am going to give a review of is taken from …

It is published under a splash, eye-catching, front page, screaming headline…

I would like to make a few remarks concerning…

The author establishes his/ her perspective on the issues…He/ she is implying that…

In his/ her first assertion the author begins his/ her defense of his/ her thesis…

The author is supplying a statistic to support the assertion…

The author is using a set of examples to show that…

The author argues that…

The author is using an appeal to emotions here…

The author uses a fact to establish the credibility of his/ her assertion…

Having set up his argument…. the author then questions the credibility of…

The author is attempting to cast doubt on the opponent's view of…

He/ she is hoping to induce the reader to accept that…

Now the author makes the connection… by paraphrasing…

This piece of evidence is being used as an additional support for …

The author expresses a belief here and uses it as evidence supporting the notion that…

The author now restates the problem and identifies the causes more clearly…In conclusion the author reasserts his position that… This is implied by reference to…

ECONOMIC SCIENCE

What does economics study?

What do you think of when you hear the word *economics*? Money, certainly, and perhaps more complicated things like business, inflation and unemployment. The science of economics studies all of these, but many more things as well. Perhaps you think that economics is all about the decisions that governments and business managers take. In fact, economists study the decisions that we all take every day.

Very simply, economics studies the way people deal with a fact of life: resources are limited, but our demand for them certainly is not. Resources may be material things such as food, housing and heating. There are some resources, though, that cannot touch. Time, space and convenience, for example, are also resources. Think of a day. There are only 24 hours in one, and we have to choose the best way to spend them. Our everyday lives are full of decisions like these. Every decision we make is a *trade-off*. If you spend more time working, you make more money. However, you will have time to relax. Economists study the trade-offs people make. They study the reasons for their decisions. They look at the effects those decisions have on our lives and our society.

What are microeconomics and macroeconomics?

Economists talk about *microeconomics* and *macroeconomics*. Microeconomics deals with people, like you and me, and private businesses. It looks at the economic decisions people make every day. It examines how families manage their household budgets. Microeconomics also deals with companies – small or large – and how they run their business. Macroeconomics, on the other hand, looks at the economy of a country – and of the whole world. Any economist will tell you, that microeconomics and macroeconomics are closely related. All of our daily microeconomic decisions have an effect on the wider world around us.

Another way to look at the science of economics is to ask, 'what's it good for?' Economists don't all agree on the answer to this question. Some practice *positive* economics. They study economic data and try to explain the behaviour of the economy. They also try to guess economic changes before they happen. Others practice *normative* economics. They suggest how to improve the economy. Positive economists say, 'this is how it is'. Normative economists say, 'we should…'.

So what do economists do? Mainly, they do three things: collect

data, create economic models and formulate theories. Data collection can include facts and figures about almost anything, from birth rates to coffee production. Economic models show relationships between these different data. For example, the relationship between the money people earn and unemployment. From this information, economists try to make theories which explain why the economy works the way it does.

History of economic thought

Economic thought goes back thousands of years. The ancient Greek, Xenophon, used the word *oikonomikos* (from oikos, meaning *family*, *household, estate,* and nomos, for *usage, law*). He was talking about skilful or clever ways to manage land and households. We could call many of Aristotle's political writing *economics,* although he did not use the word. The English word *economics* first appeared in the 19th century – two and a half thousand years after Xenophon.

Early economic thought was all about the meaning of wealth or being rich. These early thinkers asked, 'what makes a state or a country wealthy?' For nearly 2,000 years, the answer was very simple: gold. A country or nation's wealth depended on its owning precious metals. This simple view of the economy remained until medieval times.

During medieval times – roughly the period between 1100 and 1500 AD, trading between nations grew, and a new social class appeared. These were merchants, people who made their money through the buying and selling of goods, and they to write their own thoughts on the economy. They saw the economy as a way to make the state strong. For them, the nation's wealth depended on stocks of gold and the size of the population. More people meant bigger armies and a stronger state.

These were still simple ideas. However, daily experience had also taught people many basic economic concepts. For example, they understood the importance of trade with other states. They realized that scarcity makes things more expensive and abundance makes them cheaper.

Modern economics was really born in the 19th century. At this time, thinkers like Adam Smith wrote down ideas that are still important today. Adam Smith is often called *the Father of Modern Economics,* although the science was called *political economy* then. Smith realized that a nation's wealth depended on its ability to produce goods. The value of these goods depended on the cost of production. The cost of production depended on the cost of workers, raw materials and land. This was really the first example of

macroeconomics.

Smith and other classical economists were writing at a time of great change. The industrial revolution had begun. Paper money began to replace precious metals. The middle classes were growing stronger. Economists' theories echoed these changes. They wrote about the division of labour (each worker taking their part in the production process). They discussed the problems of population growth. They influenced thinking about social classes.

For classical economists, the value of goods depends on the cost of production. However, the price of goods is not always the same as their real cost. Later economists developed new theories to explain this *weakness* in classical economics. These are known as the *neoclassical* economists and they were writing at the end of the 19th and early 20th centuries.

In neoclassical economics, supply and demand make the economy work. In other words, the price of goods depends on how much people want them and how easily they can be found. Consumers want satisfaction from their resources (time and money). Firms want profit. In neoclassical economics, this is the basic relationship in the economy. These ideas are still the basis of economic thinking today.

Econometrics

Economists like to make theories. They theorise about why inflation happens, for example, or what causes unemployment. But theories are not useful if you cannot test them. This is true for all sciences, and the same for economics.

To test a theory, you first need to gather what scientists call *empirical* evidence. That's evidence that can be measured, like money spent or babies born. When you have collected the evidence, you're ready to do the maths and statistics to test your theory. Economists call their maths *econometrics.*

Let's take an example. Imagine that you want to find out why some people save more money than others. You may think that this depends on two things: how much money they earn (their income) and how happy they generally are about saving money. We can express your theory as an econometrics formula:

amount someone saves = their income x their happiness to save

Of course, we can't measure *happiness* to *save* exactly, but with econometrics mathematics we can give it a value. Then we can see how that value differs between groups of people or cultures. Econometrics is about findings relationships between variables – in

other words relationships between values that change. Economists try to find out if variable A changes every time value B changes. They want to find out if variable A is dependent on variable B. This is called analysis, and there are two main kinds of econometric analysis: *time-series* analysis and *cross-sectional* analysis.

Time-series analysis shows how variables change over a period of time. How salaries increased over the last century, for example. Cross-sectional analysis compares variables at one point in time. The salaries of men compared to women right now, for example. Of course, economists like to make things more complicated than that. Sometimes they combine cross-sectional with time-series analysis, and this is called *panel data* analysis.

As we said earlier, econometrics is good for testing economic theories. However, there is also a practical side to econometrics. The same maths and statistics are used by governments and business managers, as well as academics. Econometrics can help governments and companies find out how well they are doing. With the data from all this mathematics, they can make better decisions and plan better for the future.

The law of demand

Economics can often be very confusing. Econometric formulas and impressive charts are sometimes impossible to understand. Thankfully though, some economic ideas are completely obvious. One of these ideas is the *law of demand.* Economists are always disagreeing with each other, but the law of demand is the only thing they all agree on. They all agree on it because it makes sense even to non-economists like you and me.

Demand is how much of the same good or service people would like to buy. The law of demand says that demand for something falls as its price rises. Economists show this concept with the *demand curve.*

The reason why the law of demand works is quite obvious: the money we have is limited. If something becomes more expensive, we will have less money available to spend on our other needs. If the product or service is not a necessity, we will decide to buy less of it.

Most rules have exceptions, but economists agree that there are very few exceptions to the law of demand. It even applies to basic necessities like water. When water becomes more expensive, people find ways to use less. When the government put higher taxes on petrol, people try not to use their cars so often. The fall in demand might be very small, but it is real.

So price has an effect on demand, but the strength of the effect

varies. The strength of the price/ demand relationship is called *price elasticity.* Economists use a simple econometric formula to measure price elasticity for a certain product in a particular market. This helps governments and companies set process at the correct level for a particular time and plan price increases.

Don't forget, though, that other things affect demand apart from price. For example, during a very cold winter, demand for heating fuel like gas or coal will rise at any price. If the winter is unusually warm, then demand for fuel will fall. Economists say that situations cause a *shift* in the demand curve.

The traditional economy

It's hard to imagine our lives without coins, banknotes and credit cards. Yet for most of human history people lived without money. For thousands of years human societies had very simple economies. There were no shops, markets or traders. There were no employers, paid workers or salaries. Today, we call this kind of economy the *traditional economy*, and in some parts of Asia, South America and Africa this system still exists.

People who live in a traditional economy don't have money because they don't need it. They live lives of subsistence. That means they hunt, gather or grow only enough food to live. There is almost no surplus in the traditional economy, and there is almost no property. Families may own simple accommodation, but land is shared by all the tribe. Economic decisions are taken according to the customs of the tribe. For example, every family may need to give some of the crops they grow to the tribal leader, but keep the rest for themselves. They don't do this because it makes economic sense. They do it because the tribe has always done it. It's simply a custom.

Custom, also, decides what jobs people do in the traditional economy. People generally do the jobs that their parents and grandparents did before them. Anyway, there aren't many jobs to choose from in the traditional economy. Men are hunters, farmers or both. The woman's place is at home looking after children, cooking and home-making. This division of labour between men and women is another characteristic of the traditional economy. Whatever the work is, and whoever does it, you can be sure it's hard work. This is because traditional economies have almost no technology. Physical strength and knowledge of the environment are the tools for survival.

Like any other economic system, the traditional economy has its benefits and drawbacks. Probably the biggest benefit is that these are peaceful societies. People consume almost everything they produce and own practically nothing. They are equally poor. For all

these reasons, war is almost unknown in these societies.

However, people who live in the traditional societies are among the poorest people in the world. Because custom decides what people do, nothing in these societies ever changes. Because there is no technology, people depend on nature to survive. They have no protection from environmental disasters like droughts and floods. They are always in danger of hunger and disease.

But the traditional economy is in danger itself. There are only a few examples left on the planet. In 100 years from now, it may have disappeared forever.

The market economy

Have you ever walked through a busy street market? People push their way through crowds of others in order to reach the stalls first. The air is full of deafening shouts. Stall owners yell to advertise their goods. Buyers cry out their orders. It's hard to imagine, but behind this noisy confusion is a very logical economic theory: the *market economy*.

The market economy is sometimes called the *free market*. A free market is not controlled in any way by a government. It is also free from the influence of custom or tradition. In a free market, the only reason why things are bought and sold is because there is a demand for them. Prices for goods and services are simply what people are prepared to pay. The market economy is not really controlled by anyone. It controls itself.

The street market where we began has many of the characteristics of the free market. Customers arrive at the market with a shopping list of things they need. They also come with an idea of how much they are prepared to pay. Stall owners sell what customers demand, and try to get the highest price they can for it. Supply and demand control what is on the market and how much it sells for. In the wider economy, we are all customers, and the stall owners are like companies.

The role of the company in the free market is to supply what people want. However, companies need an incentive. The incentive is profit. There are two ways for companies to make a profit. The first way is to raise their prices. The second way is to reduce their production costs. And this brings us to two more features of the market economy: *competition* and *technology.*

Competition exists in a free market because, theoretically, anyone can be a producer. This means that companies have to complete with each other for a share of the market. Competition is good for consumers because it helps to control prices and quality. If

customers aren't happy with a product or service, or if they can't afford it, they will go to a competitor.

Technology exists in s free market because producers need ways to reduce their costs. They cannot buy cheaper raw materials. Instead, they must make better use of time and labour. Technology is the use of tools and machines to do jobs in a better way. This helps companies produce more goods in less time and with less effort. The result: more profit.

People often think that most economies are free markets. However, at the macroeconomic level, a truly free market does not exist anywhere in the world. This is because all governments set limits in order to control the economy. Some governments set many limits, other governments set very few, but they all set some. For this reason, a true market economy is only theoretical. Nevertheless, many of the features of the market economy do exist in most societies today.

The planned economy

In many ways, the *planned economy* is the direct opposite of the market economy. In the market economy, the forces of supply and demand decide everything: what is produced, how much is produced, the methods of production and the price. In the planned economy, all of this is decided by the government. In every way that the market economy is *free,* the planned economy is *controlled*.

Unfortunately, no economic system is perfect. If there was a perfect system, economists wouldn't have anything to agree about! Market economies have their strengths, but they have their problems, too. Planned economies try to provide solutions to these problems. For example, the free market supplies the things that people want. However, what people want and what they need are not always the same: Fast food is always in demand, but it's bad for us. In a planned economy, the government could decide to stop fast food restaurants operating in the market.

A second problem with free markets is that producers always want the highest price. Often the poor can't afford things. In a planned economy, the government sets prices. They make sure that everyone can afford basic commodities. This is one way that planned economies try to share things equally. Another is to control how much people get paid.

In a planned economy, workers' wages depend on the service they provide to society. If people can live without their service, you get paid less. This is very different from the free market. In the free market, someone's salary mostly depends on the demand for his or

her work. If people like what you do, you get paid more.

Before 1900, there were few examples of planned economies. During the 20th century, however, the planned economy became the standard for socialist governments like the USSR and China. These countries experienced amazing economic growth in a very short time. In a market economy, it takes a long time for big industries to grow from small companies. In a planned economy, however, huge industries can grow overnight. The government simply decides to spend money on factories and factories appear. Britain, for example, took centuries to develop her steel industry in a free market economy. China developed hers in a few decades.

But, as we said, no economic system is perfect. The planned economy has many drawbacks. One of these drawbacks is problems with supply. It is difficult for governments of planned economies to know exactly how much to produce to meet demand. In a market economy, when the price of a commodity rises, this indicates a rise in demand. This warning system doesn't work in a planned economy because price is controlled by the government. The result is shortages.

When shortages happen, governments can do two things: ration goods or raise prices. In this situation, people then start to hoard things, and then problem gets even worse. As the population gets bigger, shortages like this become more common. For this reason, China – once the world's biggest planned economy – is rapidly moving towards another system: the *mixed economy*.

The mixed economy

Most economists would say that there are no examples in the world today of a completely free market or a completely controlled economy. Instead, every country operates a mixture of the two systems. Even in the economies, like the USA, there is some government control; even in the strictest planned economy there is some free enterprise.

Economies mix government control and free market values in different ways. One way is to let privately owned businesses exist alongside state run industries. The economy becomes divided between the state sector and the private sector. The state sector often includes industries that the government thinks are important and need protection from the risks of the free market. These could include public transport, hospitals, schools and the postal service. The state sector can also include large industries that are important for a country's economic health, such as oil, steel or agriculture. There are sometimes called *primary industries* because they provide basic

materials to manufacturers.

These state sector industries use money that the government collects in taxes. Often, they do not need to compete with other companies because no other company is allowed to provide the same product or service. However, many countries have recently started a process called *deregulation*.

Deregulation means freeing up the economy to allow private businesses to compete with state-run industries. The state sector should then run more efficiently in order to compete in the free market and because it now has less government protection.

Deregulation of services like telecommunications, transport and banking has happened in many countries in recent years. People have generally accepted these changes. However, generally the public is less happy when governments start talking about deregulation and health services. Many people feel that profit motivation will harm these services rather than improve them.

Another way in which economies today are mixed is that governments put limits on free enterprise. For example, governments may decide to ban trade in certain goods if they are dangerous. They may also create laws to make sure companies trade honestly or to prevent *monopolies*. If a company has a monopoly, normal market forces do not affect it. This is bad for consumers and the economy in general. Governments may also regulate methods of production. They do this to guarantee that products are safe for consumers and to protect the environment.

Many economists would agree that the mixed economy is the best system for consumers. This is because consumers have two ways to control the economy: by choosing to buy a company's goods or services and by choosing to give political parties their votes.

Consumer choices

It's a hot summer day. You've been out walking all morning and you're getting thirsty. It's also about lunchtime, and you're feeling pretty hungry, too. What luck! Here's a kiosk selling snacks. You've got six euros to spend. You can buy bars of chocolate or bottles of water … or a combination of both. Now you've got another problem: *consumer choice.*

If you're *neoclassical economist*, however, there's nothing to worry about. Neoclassical economists believe that consumers make rational choices. Before a consumer buys something, they think about the cost and the amount of satisfaction the purchase will give them. They then compare the price and satisfaction of possible alternative purchases. In the end, they buy what gives them maximum

satisfaction at the lowest cost.

So, what will you buy from the kiosk? An important deciding factor is the amount have to spend. Economists call this your *budget constraint.* Your total budget is six euros. Bottles of water are two euros each chocolate bars arc one euro each. You could buy three bottles of water, or you could buy six chocolate bars. Or you buy any combination that adds up to your total budget. We can put all if this information on a budget. The budget line shows what combinations of goods are possible.

Economists call these combinations are bundles. But when is the best bundle? This depends, on something called *utility.* Utility is the economists' for the satisfaction we get from a purchase. Each good its own utility value for the consumer. The utility of **a** bundle depends on two things: the utility of the goods in the bundle and how much of each good is in the bundle.

To understand marginal utility, just think about chocolate bars. Every time you consume a bar of chocolate, the satisfaction you get from the next bar will be less. In other words, you get less utility every time you eat another bar. This decrease in utility is called the marginal utility. The marginal utility is the one of an additional item. For example:

Bars of chocolate	Marginal utility	Total utility
0	–	0
1	10	10
2	9	19
3	8	27
4	7	34

Put very simply, budget, price and level of utility will all affect choice at the kiosk. The neoclassical theory of consumer choice says that it is possible to calculate demand for products if we know this kind of information. However, not all economists agree!

Costs and supply

Companies have to spend money in order to make money. The money they spend to manufacture their goods or provide their services are called *costs*. Costs are important. Any company that doesn't keep track of costs will soon be in trouble. And there are many different kinds of costs to keep track of such as *fixed costs* and *variable cost*.

Why are costs important? Well, for two reasons: Firstly, there is

a relationship between costs and profit. Profit is overall revenue minus costs. Secondly, there is a relationship between costs and *supply*. To understand this relationship, we need to look at some types of cost.

One type is *fixed costs*. Fixed costs are costs that don't change. They are costs that the company has to pay each month, for example, or each year. The value of fixed costs will not rise or fall in the short term. Examples include the rent the company pays, the interest they have to pay each month on any loans and the salaries they have to pay for permanent employees.

The good news about fixed costs is that they don't change with increases in production. For example, imagine a company produces 1,000 pens in January and 2,000 pens in February. The rent for the factory remains the same for both months .*Variable costs*, however, change (vary) with the size of production. The more pens the company produces, the more these costs increase. Examples of variable costs are the raw materials needed for production, the cost of electricity and the cost of maintaining machines that are working more. Also, the company may need to get more part-time employees. Their hourly pay is another variable cost. Earlier we said that the price of a product or service increases as supply increases. Variable costs are the reason why.

In a perfect world, variable costs will increase steadily as production increases. This is called *constant return to scale*. However, this is not a perfect world! Sometimes, variable costs rise at a faster rate than production. This nasty situation is called a *dis-economy of scale*. On the other hand, companies sometimes get lucky. Variable costs can rise at a much slower rate than production. This is called an *economy of scale*.

Market structure and competition

When economists talk about *market structure* they mean the way companies compete with each other in a particular market. Let's take the market for pizzas, for example. There may be many thousands of small companies all trying to win a share of the pizza market, or there may be only one huge company that supplies all the pizzas. These are two very different market structures, but there are many other possible structures. Market structure is important because it affects price. In some market structures, companies have more control over price. In other market structures, consumers have more control over price.

You can think of market structure as a kind of scale. At one end of the scale is *perfect competition* and at the other end is *pure monopoly*. In a market with perfect competition, there are many

companies supplying the same good or service, but none of them are able to control the price. This sounds fine, but in reality it is very difficult for such a market structure to exist. What's needed?

First of all, there must be many small companies competing. Each company has its own small share of the market. If one company has a much larger share than any other, it can affect price, and perfect competition will no longer exist.

Secondly, products or services from different companies must be the same. This doesn't mean that everything on the market has to be identical, but they have to be perfect substitutes. In other words, one company's product must satisfy the same need as another company's. Imagine a company produces a television that also makes tea. Its product is different from everyone else's. If it chooses to raise the price of its TVs, customers may still want to buy them because of this difference.

Thirdly, customers and companies must have perfect and complete information. This means that they know everything about the products and prices on the market and that this information is correct.

Fourthly, there mustn't be any barriers to new companies entering the market. In other words there must not be anything that helps one company stay in the market and blocks others from trading.

Finally, every company in the market must have the same access to the resources and technology they need. If all of these conditions are met, there is perfect competition. In this kind of market structure, companies are *price takers*. This is because the laws of supply and demand set the price, not the company. How does this work? Very simply! An increase in demand will make a company increase its price in order to cover costs. It might try to push its prices even higher than necessary so that it can make more profit. However, it will not be able to do this for very long. The increase in demand and the higher price will make other companies want to enter the market, too. This will drive the price back down to *equilibrium*.

Monopolies

In a monopoly, one company has a much larger market share than any other company. In fact, their share is so big that other companies cannot really compete. When there is a monopoly, the normal laws of supply and demand do not always work. Monopolies come in different kinds, but a *pure monopoly* is when there is only one company in the market providing a particular product or service. This situation, in fact, is the exact opposite of *perfect competition*. How do pure monopolies happen?

Some monopolies occur naturally. This happens when a company manages to create an *economy of scale*. An economy of scale is when variable costs of production increase more slowly than increases in supply. Every company would like to be in this situation. Unfortunately, it's not easy to achieve. Economies of scale are possible for companies which need a lot of money to set up but much less money to run. A telephone company is a good example. Telephone companies have to spend millions of pounds laying cables. However, once they have made the network, running the system does not cost so much. Any other company that wants to compete will have to make their own network. Not surprisingly, not many bother!

However, the world of business is a jungle, and there are more aggressive ways to create a monopoly. One of these is by making *takeovers*. This means that a more powerful company buys a smaller one in the same industry. Takeovers happen vertically or horizontally. In a *vertical takeover*, a company buys companies that supply it with materials or services. For example, a publishing company might buy a printing business. In a *horizontal takeover*, a company buys its competitors. The competitors then become part of the first company.

One final way a monopoly occurs is for the government to make it happen. This is called a *legal monopoly*, but not because other monopolies are illegal! It is called a legal monopoly because it is created by law. The government may decide that a competitive market is not good for a certain industry. In this case, it can make one company the only legal supplier. Sometimes, it provides the service itself. This is called a *state monopoly*. The postal service in many countries is an example of a state monopoly.

Generally, monopolies are not good for consumers. This is because in a monopoly, the laws of supply and demand do not work in the same way. Л company with a monopoly becomes a *price maker*. They have much more power to set the price for their product or service. Also, they don't usually spend money on innovation because they don't need to. The bottom line, as they say, is that monopolies mean less choice for consumers.

The labour market

In many ways the relationship between employers and workers is similar to the relationship between consumers and producers: workers offer a service (the labour they provide), employers but that service at a price they can afford (the wages they pay). As you can see, it’s a kind of market. In economics, it’s called the *labour market*.

In any market for products and services, consumers try to get the maximum utility, or satisfaction, from their purchase. This is the

same in the labour market. What do companies want from their purchase of labour? What utility do they get? The answer is increased *output*. Output is how much of the product or service the company produces. If there is an increase in demand for their product, they will need to increase output. One way to do this (but not the only way) is to take on more staff. Another is to ask staff they already have to work more hours. In both cases, the company is buying more labour.

Just like any other market, the labour market obeys the laws of supply and demand. The demand is the employers' need for labour. Supply is the labour workers provide. Just like any other commodity, there is a relationship between price and demand. As the price of labour increases, the demand decreases.

The suppliers in the labour market are workers. Just like suppliers in other markets, they want a higher price for greater supply. In other words, as supply of labour increases, they want higher wages. The wage that workers get for their labour is a compromise between what they want and what companies will pay.

However, there can be shifts in demand. These shifts can cause the overall demand for labour to increase or decrease at any wage rate. For example, if there is an increase in the demand for the end product or service, there will be an overall increase in demand for labour. However, if new technology can replace workers, then there will be an overall decrease in demand for labour.

One more thing which affects demand for labour is workers' productivity. The productivity of a worker is how much they produce in a certain time. For example, imagine that a worker makes ten pencils an hour one day, and only eight pencils an hour the next day. This is a fall in productivity. When worker productivity falls, companies will pay less for labour. They are also less likely to employ new workers.

Supply of labour

Why do people work? To make money, of course. However, nothing in economics is ever that simple. The economist will ask a further question: how much are people prepared to work? The answer to this question is much more complex. Finding the right balance between work time and leisure time is one of the trade-offs we have to make in life. The balance each person chooses depends on a number of things.

First of all. there are natural limits. There are only 24 hours in a day, and we can't spend all of them working. Most people need eight hours sleep. That brings the number of hours we can spend on work or leisure down to l6. None of us are robots, so we all need some time

to rest and switch off from work. This also brings down the possible number of working hours. Then, of course, money plays a role. The way money influences working hours, though, is quite complicated. It can be separated into two effects: *the income effect* and the *substitution effect*.

The income effect works like this: People's time is a resource. It they give up that resource for work, they need compensation. This is usually in the form of a wage for hours worked. The more compensation they gel for each hour worked, the less they will need to work People with higher rates of pay (wages) can afford to have more leisure time than people on lower rates of pay.

So far, so good. However, are people happy just sitting at home and enjoying themselves? It depends on what they'll lose. In other words, it depends on the *opportunity* cost of not working. As the hourly rate for work increases, the cost of not working also increases. This means that as the wage rate increases, people want to work more hours. This is called the substitution effect. But the substitution effect also has a limit. Eventually, people will not work more hours, no matter how good the compensation is.

A good wage rate clearly attracts more workers, and encourages them to work longer hours. However, the strength of this relationship depends on how *elastic* the labour supply is. Sometimes it is difficult for companies to find a certain kind of worker. Perhaps there are not many people with the necessary skills. Or perhaps the company is in a place where there are not many available workers. In these situations, even if employers double the wage rate, they will only attract a small number of extra workers. The labour supply is inelastic. In the opposite situation, when it is easy for companies to find workers, the labour supply becomes elastic.

Factors of production

One morning you wake up with a great idea. You've thought of a product that no one else has, and you're certain there's demand for it. But how will you turn your idea into reality? First of all you'll need raw materials to manufacture from - probably oil and metal, but also paper for packaging. You can't produce it by yourself, so you'll need people to help you make it, package it and market it. Finally, your staff will need a factory and machines to produce with. In short, you need the *factors of productions*: *land, labour* and *capital*.

The factors of production arc the starting point for all economies. No economy can exist without them. The most basic of the factors is land. When economists talk about land, however, they don't just mean space to build on or fields to grow crops. Land means

everything that nature provides and we can use for production. The land factor includes raw materials like coal, metals, oil and timber. It also includes things like water, fish and salt. So, although it seems illogical, land also means the sea!

The second factor is labour. Raw materials will just stay in the ground unless people dig them out and do something with them. Similarly, factory machines will sit doing nothing without people to operate them. Labour can mean the physical effort such as lifting, digging and building. This is called manual work. Labour also includes mental work like thinking, writing, communicating and designing. Industries that need many workers working long hours are called *labour intensive industries*. However, the quality of labour is as important as the quantity. An educated, skilled and fit workforce is more productive than an uneducated, unskilled and unhealthy one. This characteristic of the labour factor is called *human capital*. Some countries have large labour forces, but are poor in human capital because the economy lacks education and health care.

The third factor is capital. Capital includes buildings such as factories for production and warehouses for storage. It also includes the tools and equipment that workers use in the manufacturing process. In heavy industries such as shipbuilding or steel making, capital usually involves big machinery and mechanical equipment. In high-tech industries, on the other hand, capital generally means computers and complex laboratory apparatus. These days, industry tends to be more capital intensive than labour intensive.

When companies make investments, they buy new capital. There are two types of investment that companies need to make. The first is to buy new equipment so that they can expand their production. This is called *net investment*. Net investment is essential for economic growth. However, equipment gets old and needs repairing or replacing. The money spent on this kind of maintenance is called *replacement investment*. Land, labour and capital are the three factors of production identified by Adam Smith and the classical economists. However, more recent economists have identified one more factor: *entrepreneurship*. This means people like you, with great business ideas that set the economy in motion.

Division of labour

Without the factors of production, companies cannot get started. To be successful, however, they need to make good use of those resources. To make best use of labour, you need to organize it. The division of labour is one way to achieve this.

Let's take making shirts as an example. What do you need to

do to make shirts? You need to design it, find the right material, cut the material, sew the pieces together, dye the shirt and sew on the buttons. One person working on their own could probably do all these tasks. This is one way to organise labour. Another way is for the number of workers to share the job. Each worker is responsible for one task in the process. This is an example of the division of labour.

The division of labour is not a new idea. Even very early societies had some form of labour specialization. For example, in some societies men were hunters and gatherers of food, while women were responsible for child rearing. However, as societies become industrialized, the division of labour increased. Factories became the main means of production, and each factory worker became responsible for smaller and smaller stages in the process.

As each worker gets more and more experience at doing their particular task, they get better and better at it. This should improve the quality of their work. With smaller tasks to do, workers can do things automatically, without thinking about them. This will speed up their productivity, and speed up the whole production process. Finally, small tasks are easier to learn. As the division of labour increases, the amount of time needed to train each worker decreases. All of this means a more efficient and productive workforce … at least, in theory.

There is, however, a human factor to consider. Workers are not machines. Their physical and emotional health has an impact on their productivity. Repeating the same simple task over and over again is very boring. Bored workers can't concentrate easily, and their mistakes will reduce the quality of their output. In addition there is a problem of ownership. Many workers take pride in their work. They don’t just work for wages, but also because they get satisfaction from doing a good job or from creating something useful or beautiful. If you only add buttons to a shirt, you don’t feel that the shirt is your work. You can't take pride in a job that does not need skill to do. In this situation, workers become careless and their work becomes sloppy. Overall, this has a negative impact on productivity.

Thankfully, robots and machines can now do many of the mindless tasks that factory workers used to do. Nevertheless, the theory of the division of labour is still fundamental to all modern economies.

Surplus

In a free market, price is decided by the laws of supply and demand. The market price is the price that sellers are happy to take and consumers are happy to pay. It’s a compromise, but in the end everyone is happy, right? Well, not quite everyone. Some sellers will

think the market price is not a good enough reward for their efforts. They will continue to sell at a higher price, even if almost no one walks through their shop door. Similarly, some people will walk away from the market, moaning about the price and refusing to pay. You can't please everyone!

However, there will be some people who are more than happy with the market price. What makes them so cheerful? These are the people who had expected to pay a higher price, but found that the market price was actually lower. These people feel that, by paying the market price, they have got a bargain. In the jargon of economics, they have got *consumer surplus*. Consumer surplus is the difference between the price consumers are prepared to pay and the price they really do pay.

Consumers are not the only ones who enjoy surplus. There is *producer surplus*, too. Remember that the law of supply says supply rises as price rises. This is because smaller amounts cost less to produce than larger amounts. For this reason, producers would have been happy to sell some of their output below market price. However, once the market price is set, they can sell all their produce at that price.

Think about wine producers for example. The first 50 litres of their wine cost two euros per litre to produce. The next 50 litres cost three euros per litre to produce. At the market, however, they can sell all their wine at the price of three euros per litre. The extra money they make on the first 50 litres is the producer surplus. The higher the market price is, the bigger the producer surplus will be. The total is called the *aggregate producer surplus.*

Surplus is an important. In one way it is a measure of the utility that consumers gain from their purchase. It is also a measure of the profit that producers make. Moreover, consumer and surplus together are a measure of the benefit everyone gains from the economic transaction. In economist jargon, surplus is a measure of economic welfare.

Price discrimination

The market price for product is like a signpost for companies. It shows them more or less what people are prepared to pay. Nevertheless, companies can set their prices just above or just below the market price if they want. They can even choose to ignore the market price completely. In the real world of business, setting prices involves skill, guesswork and risk - taking. Companies have lots of pricing tricks which help to increase profits. One of these tricks is *price discrimination*.

Price discrimination means charging a different price for the same product to different customers. For example, you walk into a shop and buy a CD for €15. A few minutes later, I walk into the same shop and buy another copy of exactly the same CD. This time, the shopkeeper charges me € 20! That is price discrimination.

There are different types, or degrees, of price discrimination. *First degree price discrimination* is when almost every consumer pays a different price for the same product. How can this happen? Remember that the demand curve slopes downward. In theory, every consumer has their own point on the curve. In other words, each person values the product differently. You may think that an Elton John CD is worth €20, whereas I think is it only worth 50 cents! We are on different points on the demand curve. With first degree discrimination, each consumer will pay what he or she thinks the product is worth, and sellers charge each person accordingly.

This all sounds great, but it is not usually practical in the real market place. Nevertheless, it is sometimes possible. An auction, for example, works in this way. In an auction, each consumer makes a bid for the product, and the highest bid wins. In this way, the product is sold at a price that the buyer thinks is right. Auctioning is becoming more and more common on World Wide Web, and auctioning websites have become very big business.

Second degree price discrimination is more common than first degree discrimination. It involves changing price according to how much of the product is sold. For example, if a customer buys three pencils, they pay one euro per pencil. If they buy 300 pencils, they pay only 75 cents per pencil. This is a kind of reward for reward for buying large amounts. This kind of discrimination is important for retailers. It allows shopkeepers to buy goods in bulk from wholesalers at lower prices. Shopkeepers then add a markup price when they sell the goods on to ordinary customers.

What about *third degree price discrimination*? This is when certain types of customer are charged different prices. For example, pensioners and students often get discounts on public transport or for arts events. These people cannot afford the normal market price. By offering discounts, companies widen their market share but still make a profit.

Welfare economic

Behind the numbers, charts and formulas of economics, there are people. This is sometimes easy to forget. Economics isn't only about profits, losses and utility. It's about society. Economic ideas and theories often seem to be issues that are far removed from people's

everyday lives. Welfare economics, however, tries to correct this. It looks at how economic policies affect society, families and the individual.

One of the big issues in welfare economics is *equity*. Equity means fairness, and *welfare economists* are interested in measuring how fair our economic systems are. One way they do this is to look at how income and wealth are distributed among the population. Welfare economists also investigate the effects of government policy on equity. Government's main weapon to fight in equity (unfairness) is taxation. Welfare economists try to find out how taxation affects *vertical equity* and *horizontal equity*, which are two ideas that taxation systems can be based on. The idea behind the vertical equity is that people with more income will pay more that those with less income. The idea behind horizontal equity is that people with the same income will pay the same amount of tax. Ideally, a tax system will have both vertical and horizontal equity. However, some economists feel that any kind of taxation on people's earnings is unjust. They believe it is unfair to penalize entrepreneurs and hard-workers. Why should people who are less able or less hard-working be supported by others? In this view of welfare economics, in equity is a natural feature of every economic system. Trying to create equity, they say, is just a waste of time. Instead, it is better to make economic systems more efficient. A more efficient economy grows faster and everyone in society benefits. Welfare economics isn't only about the fairness of economic systems. It's also about the impact that economic choices have on our lives. Economic transactions often affect other people who are not directly involved in those transactions. Economists call these results *externalities*. Externalities are sometimes good and sometimes bad for society. For example, pollution is a *negative externality* of the car industry. But cars give people better mobility, which is a *positive externality* of the same industry. Production is not the only cause of negative externalities for society. Many are due to our use or consumption of goods. People's litter in parks and on beaches is one example, noisy neighbours playing their CD player loudly is another. These are both examples of externalities causing pollution. However, health problems from smoking and drinking alcohol are also externalities from economic transactions. These have a cost for individuals, but also for society as a whole.

Government revenue and spending

In the UK, the government spends about £500 billion a year. Where does such a huge amount of money come from? Perhaps more importantly, what does the government spend it on? The money

governments have to spend is called *revenue*. Revenue comes from several sources, including charging for services and borrowing. However, a government's main source of revenue is taxation. There are different kinds of taxes. For example, anyone with a regular income has to pay income tax on his earnings. This is a percentage of his income which goes to the government. Many countries operate a system called *progressive income tax*. Under this system, people with a higher income pay a higher percentage to the government. Another kind of tax is *value added tax*. This is paid when we buy goods or services which are not essential or are regarded as luxuries.

Taxation, however, is not only a way for a government to earn revenue. Through taxation, governments also achieve a number of other things. Income tax, for example, should help to make the income gap between the rich and the poor smaller. Tax on harmful products like tobacco and alcohol should discourage people from consuming them. Finally, taxation is a way for the government to control overall supply and demand in the market. For instance, a very high tax on a product will mean few people can buy it and therefore its market will be very small.

So, where does the money go? Revenue is generally spent on a combination of public services and something called *transfer payments.* Transfer payments are benefits that are given to families and individuals in society who need financial support. In Britain, transfer payments make up almost a third of all public spending. These payments include *safety net benefits* such as unemployment benefit and social security benefits for families who do not have enough income to get by.

Most of the rest of the revenue goes on public goods. These can be divided into two areas: *pure public goods* and *mixed public goods*. Pure public goods are things like street lighting or national defense. These are important for everyone in a society, but they cannot be supplied by private business. To understand why not, let's look at the example of street lighting. Lighting needs to be offered to everyone who uses the streets. If a private business provided street lighting, they would need charge for it. But how could they make everyone pay? Non-payers would benefit from the lighting, too. It would be impossible to stop them. This is why a government, and not private businesses, offers street lighting; everyone pay for it through the taxes.

Mixed public goods are things which people ought to have because they are beneficial, such as health care and education. Why do many governments fund these things? The reason is that having a

healthy, educated population is good for the economy and for society as a whole. People, especially those on low incomes, may not be able to spent money on these services. Governments fund the services so that everyone can afford them, and this encourages people to use them.

Poverty

Without a doubt poverty is a huge problem in the world today. Figures suggest that three billion people or half the world's population live in poverty. However, although we associate poverty with developing countries, poverty of some kind also exists in industrialised nations. For example, it is now thought that quite possibly one in every ten Americans lives in poverty. However, poverty means different things to different people. How do economists define poverty?

One measure of poverty is *absolute poverty*. People live in absolute poverty when they live on or below the *poverty line*. This is a level of income that is so low that people cannot afford the basic necessities to live, such as food, clothing and shelter. According to the World Bank, these are people who are living on two dollars a day.

However, there are one billion people in the world who live on less than one dollar a day. The World Bank defines this as *extreme poverty*.

Few people in industrialised countries live in absolute poverty, but many live in *relative poverty*. This measure of poverty takes into account the differences that exist in a population between the rich and the poor. For example, some economists say that people who earn less than half the average income live in relative poverty. In Britain, this means 14 million people.

Why does poverty still exist? There is no single answer to this question. In developing countries, causes of absolute poverty include natural disasters like droughts and floods, political corruption and war. However, in many cases people - and whole populations - are caught in a trap: the *poverty trap*.

People on a low income spend everything they have on daily necessities. They save almost nothing. In order to raise themselves out of poverty, they need education. This costs money. Even when governments provide free schooling, the poor may not send their children because they need them to work. These families cannot afford the cost of sending a child to school. Without education, the children cannot find better paid work. In this way, generations of the same family remain poor.

The same cycle that traps individuals can trap a whole

population. Economic growth depends on investment. Investment money comes from savings. A nation that has almost no savings cannot grow economically. This keeps wages low, so again people cannot save and the cycle continues.

Macroeconomics

In the 1930 one of the world's strongest economies suffered a devastating collapse. It was the American economy, and the disaster was the Great Depression. The effects of the Great Depression were felt all around the world and it brought about a change in economic thinking. Economists began to realize that looking at the behaviour of individual consumers and suppliers in the economy was not enough. Economists and governments had to understand how the whole economy worked. In other words, they had to have an understanding of macroeconomics.

Microeconomics looks at how the details of the economy work. Macroeconomics takes a few steps back and looks at the whole picture. While microeconomics looks at supply and demand for a single product or industry, macroeconomics follows supply and demand patterns for the whole economy. Whereas microeconomics is about economic events at home, macroeconomics looks at how the domestic economy interacts with the economies of other countries.

However, macroeconomics isn't only about knowing what's happening in the economy. After the shock of the Great Depression governments realized that an economy needs to be managed. Most governments aim to have steady economic growth to control inflation and to avoid recessions. Just managing an individual business is a hard enough task. How do you manage a whole economy? Governments have certain mechanisms which help them to do this.

The first of these mechanisms is *fiscal policy*. Fiscal policy refers to the tax system and to government spending. By increasing or decreasing the amount of tax people must pay, the government can affect how much money people have available to spend (*disposable income*). This, in turn, has an effect on demand in the market. By increasing or decreasing their own spending governments can have a huge effect on the growth of the economy.

The second mechanism is *monetary policy*. With its monetary policy, a government sets interest rates and also controls the amount of money that circulates in the economy. The interest rate the government sets influences the rate that commercial banks set when they lend money to customers. Interest rates have a big impact on the economy. For example, they can affect people's decisions about saving or spending money.

The third mechanism is *administrative approach*. This is a range of things that governments do to increase the supply of goods and services to the economy but without increasing prices. There are a number of ways governments try to do this. For example, improvements in education and training can make the workforce more productive. Investment in technology can make industry more efficient. Governments can also change employment and business laws to make the market more competitive.

With a combination of these methods, governments try to steer or guide the economy on a steady and predictable path. They aim for gradual economic growth and to avoid disasters like the Great Depression.

Money

The cash we use every day is something we take for granted, but for thousands of years people traded without it. Before money was invented, people used a system called bartering. Bartering is simply swapping one good for another. Imagine that you have milk, for example, and you want eggs. You simply find someone who has eggs and wants milk - and you swap! However, you can see that this isn't a very convenient way to trade.

First of all, you can't be sure that anyone will want what you've got to offer. You have to hope that you'll be lucky and find someone who has what you want and that he or she wants what you've got. The second problem with bartering is that many goods don't hold their value. For example, you can't keep your milk for a few months and then barter it. Nobody will want it!

After some time, people realised that some goods held their value and were easy to carry around and to trade with. Examples were metals like copper, bronze and gold and other useful goods like salt. These are examples of commodity money.

With commodity money, the thing used for buying goods has inherent value. For example, gold has inherent value because it is rare, beautiful and useful. Salt has inherent value because it makes food tasty. If you could buy things with a bag of salt, it meant you could keep a store of salt and buy things anytime you needed them. In other words, commodity money can store value.

Using commodity money was much more convenient than ordinary bartering, but it still had drawbacks. One of these drawbacks is that commodity money often lacks liquidity. Liquidity refers to how easily money can circulate. There is obviously a limit to how much salt you can carry around! There's another problem with commodity money: not everyone may agree on the value of the commodity which

is used as money. If you live by the sea, salt may not be so valuable to you. Money needs to be a good unit of account. In other words, everyone should know and agree on the value of a unit. This way, money can be used to measure the value of other things.

The solution is to create a kind of money that does not have any real intrinsic value, but that represents value. This is called fiat money. The coins and notes that we use today are an example of fiat money. Notes don't have any inherent value - they are just paper. However, everyone agrees that they are worth something. More importantly, their value is guaranteed by the government. This is the reason why pounds and dollars and the world's other currencies have value.

Banks

If you work, you've probably got a bank account. You could keep the money you earn each month in a box under your bed, but it wouldn't be very sensible. One reason is that it's not very safe. If your house gets burgled, you'll lose everything you've saved. Another reason is that your money will lose value.

As prices rise, the money in a box under your bed will be able to buy fewer and fewer things. Money in a bank savings account, however, will earn interest. The interest will help compensate for the effect of inflation. But banks are more than just safe places for your money. What other services do they offer?

The other main service is lending money. Individuals and businesses often need to borrow money, and they need a lender that they can trust. This is exactly what banks are - reliable lenders. In fact, most of the money that people deposit in their bank accounts is immediately lent out to someone else.

Apart from storing and lending money, banks offer other financial services. Most of these are ways of making money more accessible to customers. For example, banks help people transfer money securely. They give customers cheque books and credit cards to use instead of cash. They provide ATM machines so that people can get cash any time of the day or night.

But how do banks make a living? Basically, they make a living by charging interest on loans. Of course, when you make a deposit into a bank savings account, the bank pays you interest on that money. However, the rate they pay savers is less than the rate they charge borrowers. The extra money they make by charging interest on loans is where banks earn most of their money.

For banks, interest is also a kind of security. Sometimes people do not pay back money they borrow. This is called defaulting on a

loan. When someone defaults on a loan, the bank uses money earned from interest to cover the loss.

Monetary policy

Monetary policy is another tool that governments use to control the economy. Monetary policy mainly involves making changes to the interest rate. It can also involve changing the amount of money that circulates round the economy. However, this second kind of monetary policy isn't used very often because it can lead to inflation. Changing interest rates, on the other hand, is a method that is used quite frequently for slowing down or speeding up the economy. So how does it work?

Basically, commercial banks - the ones that you and I use to keep our savings in and to borrow from - borrow their money from the country's central bank. This is the national or government bank, and it has the power to set interest rates. The interest rate of the central bank will influence the rates commercial banks set for their customers. When interest rates go up, borrowing money becomes more expensive. When they go down, it becomes cheaper.

People get loans from banks for all sorts of reasons, but the biggest loan most people take out is to buy a house. This kind of loan is called a mortgage. When interest rates increase, mortgages become more expensive. People who already have a mortgage will need to pay more on their repayments, and will have less money to spend on other things. Fewer people will want to buy new houses and house prices will fall.

In turn, home owners will feel less confident about their own wealth and will spend less. As a result, the economy slows down. A fall in interest rates will have the opposite effect on the house buying chain.

Consumers also buy other things using borrowed money. This is called buying on credit, and interest rates will also affect how much people spend on credit. Purchases made using credit cards are now a huge proportion of total spending in many countries. This means that interest rate changes have a big impact on consumer spending and the economy as a whole.

Companies, too, are affected by interest rate changes. When interest rates are low, they feel more confident about investing in order to expand their business. Low interest rates will encourage them to take out loans in order to build factories, buy machines and increase production. All of this increases the size of national output. Again, higher interest rates will have the opposite effect.

Finally, interest rates can have an effect on the amount of

exports a country sells. This is because the value of a currency (the exchange rate) often falls when the interest rate falls. When the value of a currency falls, a nation's products and services become cheaper for customers from other countries. This increases export sales, and more money comes into the economy. And, of course, a rise in interest rates will mean a rise in the exchange rate. This will reduce export sales, and reduce the total output of the economy.

Interest rates and the money market

Economic growth is a plus, but, like all good things, it's best not to have too much at once. If the economy grows too rapidly, the result can be inflation. Steady growth is best, and governments use fiscal and monetary policy tools to achieve this. For example, they set interest rates in order to control borrowing and investment However, the government can't just state, today's interest rate is four per cent' and expect all the other banks to follow. As usual, things are a bit more complicated!

The interest rate is not really set government at all, but by the levels of demand and supply of money in the money market. Imagine that money is like any other commodity, and the price of money is the interest rate. Banks can charge any interest rate that customers are willing to pay if there is a limited amount of m available, the suppliers (the banks) will cha a higher price (the interest rate) as demand for money increases. Demand comes from the public who want to spend money to buy things and from businesses who want to invest money in order to grow Just like other commodities, demand for money will fall as the price (interest rate) rises. The interest rate will be set by the market. It will be where the demand and supply curves meet the equilibrium point.

Also, just like other markets, there can be shifts in the demand and supply curves. When shifts happen, the equilibrium point (the interest rate that is set) changes. This new interest rate may e above or below the government's target. What can they do about it? One thing they can do is to influence the supply of money in the market.

What exactly is the money supply and how can the government influence it? Obviously, the money supply includes all the notes and coins in purses, pockets and cash tills. Some of this money will be money that has been borrowed from banks, so loans form part of the money supply too. The supply also includes money that people and companies have in bank and the accounts, money that banks have in their reserve accounts in the central government bank.

Remember that banks lend most of the money that customers deposit. When customers want to make withdrawals, the bank takes

cash from its reserve account with the central government bank. If the commercial bank has a shortage of cash in its reserve account, it is obliged to borrow from the central bank. When a commercial bank borrows from the central bank, it must borrow at the government's rate of interest. This is how the government can influence the interest rate equilibrium point of the market. However, the government needs to ensure that the end of each day the commercial banks have a shortage of cash. And, of course, they have ways of doing this!

Inflation

Inflation is an overall increase in prices over a certain period of time. It's also a worry for anybody who's trying to make ends meet, and headache for many governments. The rate of inflation is often in the headlines. However, inflation isn't really news. In most of Europe, for example, prices have risen year after year for at least the last 50 years. Deflation (overall decrease in prices) does happen occasionally, but the trend is mostly for the cost of living to increase.

There are lots of ways to measure inflation. One of the most popular ways is the retail price index. This is calculated by recording increases in price for a range of goods and services. This is sometimes called a basket of goods, some of the goods are weighted more heavily than others because they are more important. For example, food will be weighted more than the cost of a cinema ticket, because a 5% increase in food is more important than a 10% increase in the cost of seeing a film. Inflation is worked out from an average of all the price increases in the basket.

Inflation can happen for a number of reasons, but economists say there are two main culprits. These are demand-pull inflation and cost-push inflation. Demand-pull inflation can happen when the economy is growing fast. Aggregate demand begins to grow faster than suppliers can cope with. This causes a shortage, and prices rise. At first, customers may be able to pay the higher prices, and demand grows again. This forces prices up even more, and the cycle continues.

One of the characteristics of demand-pull inflation is that there is often too much money going round the economy. This is explained by the quantity theory of money. This theory uses the following equation:

money supply x velocity = average price x transactions

Velocity is the speed that money is passed on from one person to another. Some economists say that velocity and the number of transactions don't really change. The only things that change in this equation are the money supply and average prices. This means that

when the money supply increases, prices will increase too. For this reason, printing money is rarely a solution for economic crises.

Cost-push inflation, on the other hand, occurs when prices rise without an increase in demand. This happens when suppliers' variable costs increase sharply. For example, workers may demand higher wages or raw materials may become more expensive. Producers then pass these increases on to consumers by raising prices. so, as usual, we are the ones who pay!

Unemployment

There will always be a certain amount of unemployment in the economy. When economists talk about full employment they mean that everyone who can work and wants to work has got a job. Able workers who are not working are simply not happy with the salaries that are offered – or just can't be bothered!

However, economies rarely reach full employment. There are a number of reasons for this, and a number of different types of unemployment. One of these is cyclical unemployment. This type of unemployment varies with the growth and recession cycle of the economy. As the economy grows, demand for labour grows and unemployment falls. As the economy contracts, unemployment grows.

A second kind of unemployment is structural unemployment. This occurs when changing public tastes or advances in technology cause a fall in demand for some types of work. For example, computer technology has revolutionized the printing industry, and many traditional printers' jobs have become obsolete. Sometimes whole regions of a country suffer from high structural unemployment. The north-east of England, for example, was famous for many years for its shipbuilding industry. Competition from abroad forced many shipyards to close. This caused huge unemployment in the region.

How long structural unemployment lasts will depend on two things. Firstly, how easily the workforce can retrain for new jobs. This may be difficult for older workers who find it hard to learn new skills. There is also the question of who pays for the training. The second issue is mobility. Workers who are able to relocate easily to another part of the country will find new jobs more quickly.

There are two other kinds of unemployment which we should mention here. These are less serious, perhaps, but they are still difficult for governments to get rid of. The first is frictional unemployment.

This is a natural kind of unemployment that occurs when someone leaves a job and is looking for another one that suits them. Frictional unemployment often happens because people want to leave

their jobs in order to change careers. Few people walk straight into another job. However, when the economy is in recession, frictional unemployment will be more common because jobs are harder to find.

The second kind is seasonal unemployment. Some industries have busy periods and periods where there is no work at all. Some freelance farm workers, for example, get most of their work in the spring and summer. Like structural unemployment, seasonal unemployment can affect whole regions of a country. Areas that rely on summer tourism, for example, suffer serious unemployment during the autumn and winter months.

Economic growth

Many millions of people enjoy a quality of life today that previous generations could not have dreamed of. Home ownership, private cars and holidays are now standard for most families in industrialized countries. And yet at the same time, billions of people in other countries live without even clean drinking water. How can this be? The answer is that the fortunate few live in countries with sustained economic growth.

An economy is growing when the gross national product is increasing year after year. When economists calculate economic growth, though, they must take into account the effects of inflation. For example, imagine that the gross national product of a country increased from $500 billon to$ 510 billion from one year to another. That's an increase of two per cent in output. Very impressive! However, if the rate of inflation was two per cent, then there has been no real growth at all.

The other thing to remember about economic growth is that not all growth is good. Governments want steady, sustainable growth. Sudden, sharp increases in growth – a boom – can cause the economy to overheat and fall into recession. For many economies, the long run growth over many years is steady, but the short run is a roller- coaster ride of boom and depression. For instance, the long run growth of the UK economy since 1950 has been a steady 2.5% per year. However, if you look closely at any decade you'll see that there is a cycle of growth, recession and recovery. The truth is, steady growth in the short term is very hard to achieve.

Nevertheless, many countries are still struggling to achieve any kind of growth at all. Why is this? What is necessary for growth to happen? Many economists have tried to find the answer to this question, and there are plenty of theories to choose from. However, most economists agree that there things are essential for economic growth to occur: capital growth, savings and technological progress.

Capital refers to the factories and machinery that the labour force uses to turn raw materials into products. More workers and more raw materials will only lead to a certain amount of growth. Eventually, the economy needs more capital for the labour to use. Capital growth can also include training and education for the labour force. This makes the workforce more efficient, creative and productive.

Of course, someone has to pay for the new machines and training. In other words, capital growth needs investment. Money for investment needs to be borrowed from banks. Banks can only lend if customers make savings. This is why savings are so important for growth. However the economy will not grow if everyone is saving and no one is spending. Getting the right balance between consumption and saving is another part of the challenge of economic growth.

But above all, technology is the real miracle worker of economic growth. An advance in technology can increase productivity from the same amount of capital and resources: just what the chancellor ordered!

The business cycle

In the long term, over many years, an economy will grow at a steady rate. However, the climb up the hillside of economic growth is actually quite rocky. Long-term growth is made up of many short-term steps. Each short-term step may last for five or ten years. Over this short-term period the economy goes through a cycle of growth and recession. This is called the *trade* or *business cycle*, and it has four stages: *boom, slump, recession* and *recovery*.

During a boom, everything is good. Demand for goods and services is high and business is going well. To meet demand, companies need to take on more staff, so unemployment is low. Confidence is in the air! Consumers feel confident about spending because their jobs seem secure. What is more, interest rates are reasonable, so people take out loans and use their credit cards. Low interest rates also encourage companies to invest in new capital, and businesses grow. Governments are happy too, because tax revenues are increasing. However, the government has to be careful. Boom economies are always in danger of overheating. Demand-pull or cost-push inflation will eventually bring the good times to an end.

When the slump comes, the economy continues to grow, but no so fast. Once inflation starts to rise, confidence falls. The government have probably put up interest rates to slow down borrowing. People with mortgages have to spend more money to pay off their debt, so they have less to spend on other things. Higher

interest rates discourage business investment. Things are moving slowly, and people just hope that the economy will improve again. But will it?

If the government have not acted quickly enough, its fiscal and monetary policy changes may be too late. In this case, recession is inevitable. Some economists say a recession exists when the current rate of growth falls below the long-term rate of growth. Others say a recession is when there is no growth at all, and the economy actually shrinks. Whatever it is, a recession is bad news. Companies have to reduce costs because turnover is so low. They first thing they do is to lay off staff. If the recession is very bad, some companies may even go bankrupt and close. When this happens, thousands of workers may lose their jobs. As unemployment rises, the government needs to spend more on providing unemployment benefit for those who are out of work. In the worst recessions, these conditions can last for a number of years.

Eventually, with good government policy and a demand for goods or services from healthier economies abroad recovery will come. Slowly, confidence returns, investment grows and the cycle begins again.

The open economy

All through history, people from one society have been trading with people from another. Three thousand years ago, for example, the Phoenicians of the Mediterranean built an economy almost completely on foreign trade. In the jargon of economics, the Phoenicians had an open economy, and almost every economy since theirs has been open too.

When an economy is open, this basically means that it imports and exports goods and services. What are the benefits of doing this? First of all, if you trade with other economies, you can import goods that do not exist in your economy. These may be products that your economy cannot manufacture, but they may also be raw materials. With a wider range of raw materials, an economy is able to use its capital and labour to produce a wider range of products. In this way, importing can actually help an economy grow. What's more, if you allow imports from other countries, then you will have trading partnerships. This means that you can export to countries. If you have customers all over the world, your economy will grow faster.

Open economies are good for consumers, too. If the economy allows imports from abroad, there will be a greater variety of goods available locally. When products are available locally, imports of the same products should help to keep prices down and quality high. This

is because local companies will have to compete with foreign companies, and more competition will mean better quality and greater value for money.

Economists describe imports and exports of material products as visible - because you can really see and touch them. Examples of visible exports and imports are food stuffs, furniture and electronic equipment. However, there are also invisible imports and exports. These are mainly services, but can include all sorts of things. Examples of invisible exports and imports include banking services, insurance products, educational courses and tourism.

Opening up economies, however, does bring problems. One of the main difficulties is keeping a good balance of trade. Every time a country manages to sell a product or service abroad, this means money will flow into the economy. On the other hand, every time someone buys from abroad, money flows out of the country. Over time, if the flow of money out of the economy is greater than the flow of money into the economy, then there is a trade deficit. This is not a good situation to be in. The challenge for governments is to keep the flow of trade equal in both directions, or to achieve a trade surplus. This is when total exports are greater than total imports.

Exchange rates

The UK has sterling, the USA has dollars and Russia has the rouble. Almost every country has its own currency. Some countries in an economic zone share a currency, for example the 13 European countries that share the euro, but this is quite rare. If I live in a Eurozone country and I want to buy something from the UK, I must buy it using UK sterling. To do this I need to exchange my euros for sterling. The amount of sterling I can swap for each euro depends on the exchange rate.

For example, if the exchange rate is £1 = €1.50 and the camera I want to buy is worth £100, then to buy the camera I must spend 100 x 1.5 = €150. Similarly, if someone in the UK wants to buy something from a Eurozone country, they must exchange their sterling for euros. If the computer they want to buy costs €500, then they must spend 500 x 0.75 = £375.

Most exchange rates, however, do not stay the same. They are changing all the time. Imagine that a few days later the exchange rate changes to £1 = €1.45. This would make the camera cheaper for me, but the computer more expensive for the buyer in the UK. In other words, sterling has got weaker against the euro and the euro has got stronger against sterling.

But what makes the exchange rate change? To understand this,

just think of the exchange rate as the price of the currency. Just like any other commodity, the price of a currency is decided by supply and demand in the market. The rate set will be the equilibrium point where supply and demand meet.

Where does demand for a currency come from? Let's take the euro, for example. Exports from the Eurozone need to be paid for in euros. This means the buyers of those exports need to buy euros to make their purchases. So the demand for euros increases. Also, investors from outside the Eurozone may want to invest their money there because they think they will make a profit. To do this, they must buy euros, and again the demand for euros increases. The supply of euros on the international money markets comes from people who want to sell euros. If people want to buy imports from countries outside the Eurozone, or if they want to invest in countries outside the Eurozone, they must sell their euros to buy other currencies. So the supply of euros increases.

A change in the exchange rate of a currency can have a big impact on the economy. For example, it can have a big impact on the economy's balance of payments. As we saw in the example earlier, when a currency gets stronger, imports become cheaper. But at the same time, exports to overseas customers get more expensive. This will probably mean that more money will flow out of the economy than in.

ENGINEERING SCIENCE

Engineering Drawings

An engineering drawing, a type of technical drawing, is used to fully and clearly define requirements for engineered items.

Engineering drawing (the activity) produces engineering drawings (the documents). More than merely the drawing of pictures, it is also a language—a graphical language that communicates ideas and information from one mind to another. Most especially, it communicates all needed information from the engineer, who designed a part, to the workers, who will make it.

Engineering drawing and artistic drawing are both types of drawing, and either may be called simply "drawing" when the context is implicit. Engineering drawing shares some traits with artistic drawing in that both create pictures. But whereas the purpose of artistic drawing is to convey emotion or artistic sensitivity in some way (subjective impressions), the purpose of engineering drawing is to convey information (objective facts). One of the corollaries that follows from this fact is that, whereas anyone can appreciate artistic drawing (even if each viewer has his own unique appreciation), engineering drawing requires some training to understand (like any language); but there is also a high degree of objective commonality in the interpretation (also like other languages).[1] In fact, engineering drawing has evolved into a language that is more precise and unambiguous than natural languages; in this sense it is closer to a programming language in its communication ability. Engineering drawing uses an extensive set of conventions to convey information very precisely, with very little ambiguity. Engineering drawing is a type of technique which is used to fully and clearly defined requirements for engineered items. Engineering drawing is one of the best way to communicate one idea easily to other person.

The process of producing engineering drawings, and the skill of producing those, is often referred to as technical drawing or drafting although technical drawings are also required for disciplines that would not ordinarily be thought of as parts of engineering (such as architecture, landscaping, cabinet making, and garment-making).

Persons employed in the trade of producing engineering drawings were called draftsmen (or draughtsmen) in the past. Although these terms are still in use, the non-gender-specific terms draftsperson and drafter are now more common.

Standardization and disambiguation

Engineering drawings specify requirements of a component or

assembly which can be complicated. Standards provide rules for their specification and interpretation. In 2011, a new revision of ISO 8015 was published containing the Invocation Principle. This states that, "Once a portion of the ISO geometric product specification (GPS) system is invoked in a mechanical engineering product documentation, the entire ISO GPS system is invoked." It also goes on to state that marking a drawing "Tolerancing ISO 8015" is optional. The implication of this is that any drawing using ISO symbols can only be interpreted to ISO GPS rules. The only way not to invoke the ISO GPS system is to invoke a national or other standard. Now in 2015 there is a new standardisation called BS 8888, this is now used for all standard and technical drawings.

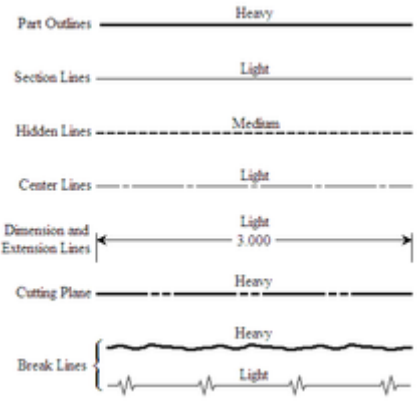
Since there are only two widely standardized definitions of size, there is only one real alternative to ISO GPS, i.e. ASME Y14.5 and Y14.5M (most recently revised in 2009). Standardization also aids internationalization, because people from different countries who speak different languages can read the same engineering drawing, and interpret it the same way. To that end, drawings should be as free of notes and abbreviations as possible so that the meaning is conveyed graphically.

Important note! The 'manufacturing' of a technical drawing however is as difficult as the actual production of the design it describes. Therefore engineers must think very clearly about what is placed on a drawing, i.e Dimensioning and tolerancing principles. (GD&T). Ideally each party knows exactly how to read and interpret such principles, but practise shows it is not as easy.

Drawings convey the following critical information:

- Geometry – the shape of the object; represented as views; how the object will look when it is viewed from various angles, such as front, top, side, etc.
- Dimensions – the size of the object is captured in accepted units.
- Tolerances – the allowable variations for each dimension.
- Material – represents what the item is made of.
- Finish – specifies the surface quality of the item, functional or cosmetic. For example, a mass-marketed product usually requires a much higher surface quality than, say, a component that goes inside industrial machinery.

Line styles and types



Standard engineering drawing line types

A variety of line styles graphically represent physical objects. Types of lines include the following:

- visible – are continuous lines used to depict edges directly visible from a particular angle.
- hidden – are short-dashed lines that may be used to represent edges that are not directly visible.
- center – are alternately long- and short-dashed lines that may be used to represent the axes of circular features.
- cutting plane – are thin, medium-dashed lines, or thick alternately long- and double short-dashed that may be used to define sections for section views.
- section – are thin lines in a pattern (pattern determined by the material being "cut" or "sectioned") used to indicate surfaces in section views resulting from "cutting." Section lines are commonly referred to as "cross-hatching."
- phantom - (not shown) are alternately long- and double short-dashed thin lines used to represent a feature or component that is not part of the specified part or assembly. E.g. billet ends that may be used for testing, or the machined product that is the focus of a tooling drawing.

Lines can also be classified by a letter classification in which each line is given a letter.

- Type A lines show the outline of the feature of an object. They are the thickest lines on a drawing and done with a pencil softer than HB.
- Type B lines are dimension lines and are used for dimensioning, projecting, extending, or leaders. A harder pencil

should be used, such as a 2H pencil.

- Type C lines are used for breaks when the whole object is not shown. These are freehand drawn and only for short breaks. 2H pencil
- Type D lines are similar to Type C, except these are zigzagged and only for longer breaks. 2H pencil
- Type E lines indicate hidden outlines of internal features of an object. These are dotted lines. 2H pencil
- Type F lines are lines, except these are used for drawings in electrotechnology. 2H pencil
- Type G lines are used for centre lines. These are dotted lines, but a long line of 10–20 mm, then a gap, then a small line of 2 mm. 2H pencil
- Type H lines are the same as type G, except that every second long line is thicker. These indicate the cutting plane of an object. 2H pencil
- Type k lines indicate the alternate positions of an object and the line taken by that object. These are drawn with a long line of 10-20 mm, then a small gap, then a small line of 2 mm, then a gap, then another small line. 2H pencil.

Multiple views and projections

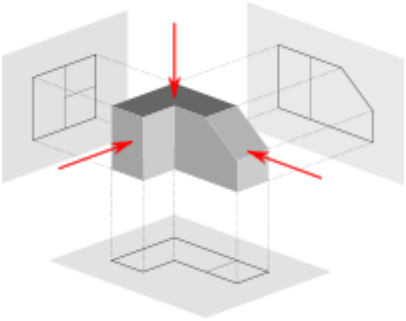
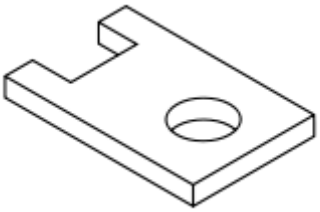


Image of a part represented in First Angle Projection

Symbols used to define whether a projection is either First Angle (left) or Third Angle (right).



Isometric view of the object shown in the engineering drawing below.

Main article: Graphical projection

In most cases, a single view is not sufficient to show all necessary features, and several views are used. Types of views include the following:

Orthographic projection

The orthographic projection shows the object as it looks from the front, right, left, top, bottom, or back, and are typically positioned relative to each other according to the rules of either first-angle or third-angle projection. The origin and vector direction of the projectors (also called projection lines) differs, as explained below.

- In first-angle projection, the projectors originate as if radiated from a viewer's eyeballs and shoot through the 3D object to project a 2D image onto the plane behind it. The 3D object is projected into 2D "paper" space as if you were looking at a radiograph of the object: the top view is under the front view, the right view is at the left of the front view. First-angle projection is the ISO standard and is primarily used in Europe.
- In third-angle projection, the projectors originate as if radiated from the 3D object itself and shoot away from the 3D object to project a 2D image onto the plane in front of it. The views of the 3D object are like the panels of a box that envelopes the object, and the panels pivot as they open up flat into the plane of the drawing. Thus the left view is placed on the left and the top view on the top; and the features closest to the front of the 3D object will appear closest to the front view in the drawing. Third-angle projection is primarily used in the United States and Canada, where it is the default projection system according to ASME standard ASME Y14.3M.

Until the late 19th century, first-angle projection was the norm in North America as well as Europe; but circa the 1890s, the meme of third-angle projection spread throughout the North American

engineering and manufacturing communities to the point of becoming a widely followed convention, and it was an ASA standard by the 1950s. Circa World War I, British practice was frequently mixing the use of both projection methods.

As shown above, the determination of what surface constitutes the front, back, top, and bottom varies depending on the projection method used.

Not all views are necessarily used. Generally only as many views are used as are necessary to convey all needed information clearly and economically.[6] The front, top, and right-side views are commonly considered the core group of views included by default, but any combination of views may be used depending on the needs of the particular design. In addition to the 6 principal views (front, back, top, bottom, right side, left side), any auxiliary views or sections may be included as serve the purposes of part definition and its communication. View lines or section lines (lines with arrows marked "A-A", "B-B", etc.) define the direction and location of viewing or sectioning. Sometimes a note tells the reader in which zone(s) of the drawing to find the view or section.

Auxiliary projection

An auxiliary view is an orthographic view that is projected into any plane other than one of the six principal views.[8] These views are typically used when an object contains some sort of inclined plane. Using the auxiliary view allows for that inclined plane (and any other significant features) to be projected in their true size and shape. The true size and shape of any feature in an engineering drawing can only be known when the Line of Sight (LOS) is perpendicular to the plane being referenced. It is shown like a three-dimensional object.

Isometric projection

The isometric projection shows the object from angles in which the scales along each axis of the object are equal. Isometric projection corresponds to rotation of the object by ± 45° about the vertical axis, followed by rotation of approximately ± 35.264° [= arcsin(tan(30°))] about the horizontal axis starting from an orthographic projection view. "Isometric" comes from the Greek for "same measure". One of the things that makes isometric drawings so attractive is the ease with which 60 degree angles can be constructed with only a compass and straightedge.

Isometric projection is a type of axonometric projection. The other two types of axonometric projection are:

- Dimetric projection
- Trimetric projection

Oblique projection

An oblique projection is a simple type of graphical projection used for producing pictorial, two-dimensional images of three-dimensional objects:

- it projects an image by intersecting parallel rays (projectors)
- from the three-dimensional source object with the drawing surface (projection plan).

In both oblique projection and orthographic projection, parallel lines of the source object produce parallel lines in the projected image.

Perspective

Perspective is an approximate representation on a flat surface, of an image as it is perceived by the eye. The two most characteristic features of perspective are that objects are drawn:

- Smaller as their distance from the observer increases
- Foreshortened: the size of an object's dimensions along the line of sight are relatively shorter than dimensions across the line of sight.

Section Views

Projected views (either Auxiliary or Orthographic) which show a cross section of the source object along the specified cut plane. These views are commonly used to show internal features with more clarity than may be available using regular projections or hidden lines. In assembly drawings, hardware components (e.g. nuts, screws, washers) are typically not sectioned.

Scale

Main articles: Architect's scale, Engineer's scale, and Metric scale

Plans are usually "scale drawings", meaning that the plans are drawn at specific ratio relative to the actual size of the place or object. Various scales may be used for different drawings in a set. For example, a floor plan may be drawn at 1:50 (1:48 or $^1/_4$″ = 1′ 0″) whereas a detailed view may be drawn at 1:25 (1:24 or $^1/_2$″ = 1′ 0″). Site plans are often drawn at 1:200 or 1:100.

Scale is a nuanced subject in the use of engineering drawings. On one hand, it is a general principle of engineering drawings that they are projected using standardized, mathematically certain projection methods and rules. Thus, great effort is put into having an engineering drawing accurately depict size, shape, form, aspect ratios between features, and so on. And yet, on the other hand, there is another general principle of engineering drawing that nearly

diametrically opposes all this effort and intent—that is, the principle that users are not to scale the drawing to infer a dimension not labeled. This stern admonition is often repeated on drawings, via a boilerplate note in the title block telling the user, "DO NOT SCALE DRAWING."

The explanation for why these two nearly opposite principles can coexist is as follows. The first principle—that drawings will be made so carefully and accurately—serves the prime goal of why engineering drawing even exists, which is successfully communicating part definition and acceptance criteria—including "what the part should look like if you've made it correctly." The service of this goal is what creates a drawing that one even could scale and get an accurate dimension thereby. And thus the great temptation to do so, when a dimension is wanted but was not labeled. The second principle—that even though scaling the drawing will usually work, one should nevertheless never do it—serves several goals, such as enforcing total clarity regarding who has authority to discern design intent, and preventing erroneous scaling of a drawing that was never drawn to scale to begin with (which is typically labeled "drawing not to scale" or "scale: NTS"). When a user is forbidden from scaling the drawing, s/he must turn instead to the engineer (for the answers that the scaling would seek), and s/he will never erroneously scale something that is inherently unable to be accurately scaled.

But in some ways, the advent of the CAD and MBD era challenges these assumptions that were formed many decades ago. When part definition is defined mathematically via a solid model, the assertion that one cannot interrogate the model—the direct analog of "scaling the drawing"—becomes ridiculous; because when part definition is defined this way, it is not possible for a drawing or model to be "not to scale". A 2D pencil drawing can be inaccurately foreshortened and skewed (and thus not to scale), yet still be a completely valid part definition as long as the labeled dimensions are the only dimensions used, and no scaling of the drawing by the user occurs. This is because what the drawing and labels convey is in reality a symbol of what is wanted, rather than a true replica of it. (For example, a sketch of a hole that is clearly not round still accurately defines the part as having a true round hole, as long as the label says "10mm DIA", because the "DIA" implicitly but objectively tells the user that the skewed drawn circle is a symbol representing a perfect circle.) But if a mathematical model—essentially, a vector graphic—is declared to be the official definition of the part, then any amount of "scaling the drawing" can make sense; there may still be

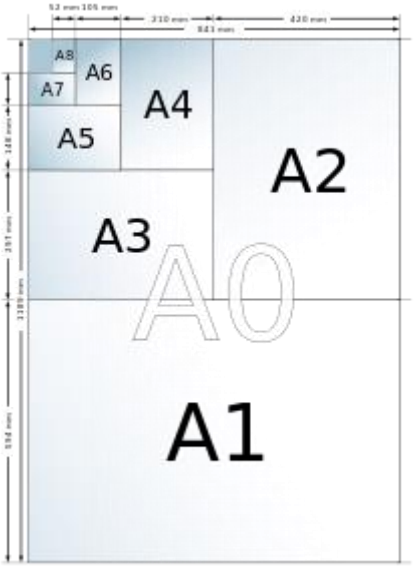
an error in the model, in the sense that what was intended is not depicted (modeled); but there can be no error of the "not to scale" type—because the mathematical vectors and curves are replicas, not symbols, of the part features.

Even in dealing with 2D drawings, the manufacturing world has changed since the days when people paid attention to the scale ratio claimed on the print, or counted on its accuracy. In the past, prints were plotted on a plotter to exact scale ratios, and the user could know that a line on the drawing 15mm long corresponded to a 30mm part dimension because the drawing said "1:2" in the "scale" box of the title block. Today, in the era of ubiquitous desktop printing, where original drawings or scaled prints are often scanned on a scanner and saved as a PDF file, which is then printed at any percent magnification that the user deems handy (such as "fit to paper size"), users have pretty much given up caring what scale ratio is claimed in the "scale" box of the title block. Which, under the rule of "do not scale drawing", never really did that much for them anyway.

Showing dimensions

Sizes of drawings

Paper size



Sizes of drawings typically comply with either of two different

standards, ISO (World Standard) or ANSI/ASME Y14.1 (American).

The metric drawing sizes correspond to international paper sizes. These developed further refinements in the second half of the twentieth century, when photocopying became cheap. Engineering drawings could be readily doubled (or halved) in size and put on the next larger (or, respectively, smaller) size of paper with no waste of space. And the metric technical pens were chosen in sizes so that one could add detail or drafting changes with a pen width changing by approximately a factor of the square root of 2. A full set of pens would have the following nib sizes: 0.13, 0.18, 0.25, 0.35, 0.5, 0.7, 1.0, 1.5, and 2.0 mm. However, the International Organization for Standardization (ISO) called for four pen widths and set a colour code for each: 0.25 (white), 0.35 (yellow), 0.5 (brown), 0.7 (blue); these nibs produced lines that related to various text character heights and the ISO paper sizes.

All ISO paper sizes have the same aspect ratio, one to the square root of 2, meaning that a document designed for any given size can be enlarged or reduced to any other size and will fit perfectly. Given this ease of changing sizes, it is of course common to copy or print a given document on different sizes of paper, especially within a series, e.g. a drawing on A3 may be enlarged to A2 or reduced to A4.

The U.S. customary "A-size" corresponds to "letter" size, and "B-size" corresponds to "ledger" or "tabloid" size. There were also once British paper sizes, which went by names rather than alphanumeric designations.

American Society of Mechanical Engineers (ASME) ANSI/ASME Y14.1, Y14.2, Y14.3, and Y14.5 are commonly referenced standards in the U.S.

Technical lettering

Technical lettering is the process of forming letters, numerals, and other characters in technical drawing. It is used to describe, or provide detailed specifications for, an object. With the goals of legibility and uniformity, styles are standardized and lettering ability has little relationship to normal writing ability. Engineering drawings use a Gothic sans-serif script, formed by a series of short strokes. Lower case letters are rare in most drawings of machines. ISO Lettering templates, designed for use with technical pens and pencils, and to suit ISO paper sizes, produce lettering characters to an international standard. The stroke thickness is related to the character height (for example, 2.5mm high characters would have a stroke thickness - pen nib size - of 0.25mm, 3.5 would use a 0.35mm pen and so forth). The ISO character set (font) has a seriffed one, a

barred seven, an open four, six, and nine, and a round topped three, that improves legibility when, for example, an A0 drawing has been reduced to A1 or even A3 (and perhaps enlarged back or reproduced/faxed/ microfilmed &c). When CAD drawings became more popular, especially using US American software, such as AutoCAD, the nearest font to this ISO standard font was Romantic Simplex (RomanS) - with a manually adjusted width factor (over ride) to make it look as near to the ISO lettering for the drawing board. However, with the closed four, and arced six and nine, romans.shx typeface could be difficult to read in reductions. In more recent revisions of software packages, the TrueType font ISOCPEUR reliably reproduces the original drawing board lettering stencil style, however, many drawings have switched to the ubiquitous Arial.

DESIGN

Design is the creation of a plan or convention for the construction of an object, system or measurable human interaction (as in architectural blueprints, engineering drawings, business processes, circuit diagrams, and sewing patterns).[1] Design has different connotations in different fields (see design disciplines below). In some cases, the direct construction of an object (as in pottery, engineering, management, coding, and graphic design) is also considered to be design.

Designing often necessitates considering the aesthetic, functional, economic, and sociopolitical dimensions of both the design object and design process. It may involve considerable research, thought, modeling, interactive adjustment, and re-design. Meanwhile, diverse kinds of objects may be designed, including clothing, graphical user interfaces, skyscrapers, corporate identities, business processes, and even methods of designing

More formally design has been defined as follows.

(noun) a specification of an object, manifested by an agent, intended to accomplish goals, in a particular environment, using a set of primitive components, satisfying a set of requirements, subject to constraints;

(verb, transitive) to create a design, in an environment (where the designer operates)[3]

Another definition for design is a roadmap or a strategic approach for someone to achieve a unique expectation. It defines the specifications, plans, parameters, costs, activities, processes and how and what to do within legal, political, social, environmental, safety and economic constraints in achieving that objective.[4]

Here, a "specification" can be manifested as either a plan or a finished product, and "primitives" are the elements from which the design object is composed.

With such a broad denotation, there is no universal language or unifying institution for designers of all disciplines. This allows for many differing philosophies and approaches toward the subject (see Philosophies and studies of design, below).

The person designing is called a designer, which is also a term used for people who work professionally in one of the various design areas, usually also specifying which area is being dealt with (such as a fashion designer, concept designer, web designer or interior designer). A designer's sequence of activities is called a design process. The scientific study of design is called design science.

Additional definitions, Design is planning to manufacture an object, system, component or structure. Then, the word "design" can be used as a noun or a verb. In a broader sense, the design is an applied art and engineering that integrate with technology.

With a design definition is fairly broad, the design has a myriad of specifications that professionals in their fields, and yet there is one institution that can collect all of the manifesto of the design as a whole, although it does not mean we do not find the schools that initiated the birth of designers.

Approaches to design

A design approach is a general philosophy that may or may not include a guide for specific methods. Some are to guide the overall goal of the design. Other approaches are to guide the tendencies of the designer. A combination of approaches may be used if they don't conflict.

Some popular approaches include:

- Sociotechnical system design, a philosophy and tools for participative designing of work arrangements and supporting processes - for organizational purpose, quality, safety, economics and customer requirements in core work processes, the quality of peoples experience at work and the needs of society
- KISS principle, (Keep it Simple Stupid), which strives to eliminate unnecessary complications.
- There is more than one way to do it (TIMTOWTDI), a philosophy to allow multiple methods of doing the same thing.
- Use-centered design, which focuses on the goals and tasks associated with the use of the artifact, rather than focusing on the end user.
- User-centered design, which focuses on the needs,

wants, and limitations of the end user of the designed artifact.

- Critical design uses designed artifacts as an embodied critique or commentary on existing values, morals, and practices in a culture.
- Service design designing or organizing the experience around a product, the service associated with a product's use.
- Transgenerational design, the practice of making products and environments compatible with those physical and sensory impairments associated with human aging and which limit major activities of daily living.
- Speculative design, the speculative design process doesn't necessarily define a specific problem to solve, but establishes a provocative starting point from which a design process emerges. The result is an evolution of fluctuating iteration and reflection using designed objects to provoke questions and stimulate discussion in academic and research settings.

Design methods is a broad area that focuses on:

Divergence – Exploring possibilities and constraints of inherited situations by applying critical thinking through qualitative and quantitative research methods to create new understanding (problem space) toward better design solutions

Transformation – Redefining specifications of design solutions which can lead to better guidelines for traditional and contemporary design activities (architecture, graphic, industrial, information, interaction, et al.) and/or multidisciplinary response.

Convergence – Prototyping possible scenarios for better design solutions that incrementally or significantly improve the originally inherited situation

Sustainability – Managing the process of exploring, redefining and prototyping of design solutions continually over time

Articulation - the visual relationship between the parts and the whole.

The role of design methods is to support design work, the aims of which can be varied, though they may include gaining key insights or unique essential truths resulting in more holistic solutions in order to achieve better experiences for users with products, services, environments and systems they rely upon. Insight, in this case, is clear and deep investigation of a situation through design methods, thereby grasping the inner nature of things intuitively.

In engineering, design is a component of the engineering process. Many overlapping methods and processes can be seen when comparing Product design, Industrial design and

Engineering. The American Heritage Dictionary defines design as: "To conceive or fashion in the mind; invent," and "To formulate a plan", and defines engineering as: "The application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems.". Both are forms of problem-solving with a defined distinction being the application of "scientific and mathematical principles". The increasingly scientific focus of engineering in practice, however, has raised the importance of new more "human-centered" fields of design.[36] How much science is applied in a design is a question of what is considered "science". Along with the question of what is considered science, there is social science versus natural science. Scientists at Xerox PARC made the distinction of design versus engineering at "moving minds" versus "moving atoms" (probably in contradiction to the origin of term "engineering - engineer" from Latin "in genio" in meaning of a "genius" what assumes existence of a "mind" not of an "atom").

Graphical language design

Graphical language design begins by identifying a preliminary set of schematics and the purpose or goals of each in terms of where and how they will support the method application process. The central item of focus is determined for each schematic. For example, in experimenting with alternative graphical language designs for IDEF9, a Context Schematic was envisioned as a mechanism to classify the varying environmental contexts in which constraints may apply. The central focus of this schematic was the context. After deciding on the central focus for the schematic, additional information (concepts and relations) that should be captured or conveyed is identified.

Up to this point in the language design process, the primary focus has been on the information that should be displayed in a given schematic to achieve the goals of the schematic. This is where the language designer must determine which items identified for possible inclusion in the schematic are amenable to graphical representation and will serve to keep the user focused on the desired information content. With this general understanding, previously developed graphical language structures are explored to identify potential reuse opportunities. While exploring candidate graphical language designs for emerging IDEF methods, a wide range of diagrams were identified and explored. Quite often, even some of the central concepts of a method will have no graphical language element in the method.

For example, the IDEF1 Information Modeling method includes the notion of an entity but has no syntactic element for an entity in

the graphical language.8. When the language designer decides that a syntactic element should be included for a method concept, candidate symbols are designed and evaluated. Throughout the graphical language design process, the language designer applies a number of guiding principles to assist in developing high quality designs. Among these, the language designer avoids overlapping concept classes or poorly defined ones. They also seek to establish intuitive mechanisms to convey the direction for reading the schematics.

For example, schematics may be designed to be read from left to right, in a bottom-up fashion, or center-out. The potential for clutter or overwhelmingly large amounts of information on a single schematic is also considered as either condition makes reading and understanding the schematic extremely difficult.

Method testing

Each candidate design is then tested by developing a wide range of examples to explore the utility of the designs relative to the purpose for each schematic. Initial attempts at method development, and the development of supporting language structures in particular, are usually complicated. With successive iterations on the design, unnecessary and complex language structures are eliminated.

As the graphical language design approaches a level of maturity, attention turns to the textual language. The purposes served by textual languages range from providing a mechanism for expressing information that has explicitly been left out of the graphical language to providing a mechanism for standard data exchange and automated model interpretation. Thus, the textual language supporting the method may be simple and unstructured (in terms of computer interpretability), or it may emerge as a highly structured, and complex language. The purpose of the method largely determines what level of structure will be required of the textual language.

Formalization and application techniques

As the method language begins to approach maturity, mathematical formalization techniques are employed so the emerging language has clear syntax and semantics. The method formalization process often helps uncover ambiguities, identify awkward language structures, and streamline the language.

These general activities culminate in a language that helps focus user attention on the information that needs to be discovered, analyzed, transformed, or communicated in the course of accomplishing the task for which the method was designed. Both the procedure and language components of the method also help users

develop the necessary skills and attunements required to achieve consistently high quality results for the targeted task.

Once the method has been developed, application techniques will be designed to successfully apply the method in stand-alone mode as well as together with other methods. Application techniques constitute the "use" component of the method which continues to evolve and grow throughout the life of the method. The method procedure, language constructs, and application techniques are reviewed and tested to iteratively refine the method.

MEASUREMENTS

Measurement is the assignment of a number to a characteristic of an object or event, which can be compared with other objects or events. The scope and application of a measurement is dependent on the context and discipline. In the natural sciences and engineering, measurements do not apply to nominal properties of objects or events, which is consistent with the guidelines of the International vocabulary of metrology published by the International Bureau of Weights and Measures. However, in other fields such as statistics as well as the social and behavioral sciences, measurements can have multiple levels, which would include nominal, ordinal, interval, and ratio scales.

Measurement is a cornerstone of trade, science, technology, and quantitative research in many disciplines. Historically, many measurement systems existed for the varied fields of human existence to facilitate comparisons in these fields. Often these were achieved by local agreements between trading partners or collaborators. Since the 18th century, developments progressed towards unifying, widely accepted standards that resulted in the modern International System of Units (SI). This system reduces all physical measurements to a mathematical combination of seven base units. The science of measurement is pursued in the field of metrology.

Measurements most commonly use the International System of Units (SI) as a comparison framework. The system defines seven fundamental units: kilogram, metre, candela, second, ampere, kelvin, and mole. Six of these units are defined without reference to a particular physical object which serves as a standard (artifact-free), with the exception of the kilogram which is still embodied in an artifact which rests at the BIPM outside Paris.

Artifact-free definitions fix measurements at an exact value related to a physical constant or other invariable phenomena in nature, in contrast to standard artifacts which are subject to deterioration or destruction. Instead, the measurement unit can only ever change through increased accuracy in determining the value of the constant it

is tied to. The seven base units in the SI system. Arrows point from units to those that depend on them. The first proposal to tie an SI base unit to an experimental standard independent of fiat was by Charles Sanders Peirce (1839–1914), who proposed to define the metre in terms of the wavelength of a spectral line. This directly influenced the Michelson–Morley experiment; Michelson and Morley cite Peirce, and improve on his method.

Standards

With the exception of a few fundamental quantum constants, units of measurement are derived from historical agreements. Nothing inherent in nature dictates that an inch has to be a certain length, nor that a mile is a better measure of distance than a kilometre. Over the course of human history, however, first for convenience and then for necessity, standards of measurement evolved so that communities would have certain common benchmarks. Laws regulating measurement were originally developed to prevent fraud in commerce.

Units of measurement are generally defined on a scientific basis, overseen by governmental or independent agencies, and established in international treaties, pre-eminent of which is the General Conference on Weights and Measures (CGPM), established in 1875 by the Treaty of the metre and which oversees the International System of Units (SI) and which has custody of the International Prototype Kilogram. The metre, for example, was redefined in 1983 by the CGPM as the distance traveled by light in free space in 1/299,792,458 of a second while in 1960 the international yard was defined by the governments of the United States, United Kingdom, Australia and South Africa as being exactly 0.9144 metres.

In the United States, the National Institute of Standards and Technology (NIST), a division of the United States Department of Commerce, regulates commercial measurements. In the United Kingdom, the role is performed by the National Physical Laboratory (NPL), in Australia by the National Measurement Institute,[7] in South Africa by the Council for Scientific and Industrial Research and in India the National Physical Laboratory of India.

The metric system is a decimal systems of measurement based on its units for length, the metre and for mass, the kilogram. It exists in several variations, with different choices of base units, though these do not affect its day-to-day use. Since the 1960s, the International System of Units (SI) is the internationally recognised metric system. Metric units of mass, length, and electricity are widely used around the world for both everyday and scientific purposes.

The metric system features a single base unit for many physical

quantities. Other quantities are derived from the standard SI units. Multiples and fractions of the units are expressed as Powers of 10 of each unit. Unit conversions are always simple because they are in the ratio of ten, one hundred, one thousand, etc., so that convenient magnitudes for measurements are achieved by simply moving the decimal place: 1.234 metres is 1234 millimetres or 0.001234 kilometres. The use of fractions, such as 2/5 of a metre, is not prohibited, but uncommon. All lengths and distances, for example, are measured in metres, or thousandths of a metre (millimetres), or thousands of metres (kilometres). There is no profusion of different units with different conversion factors as in the Imperial system which uses, for example, inches, feet, yards, fathoms, rods.

International System of Units

The International System of Units (abbreviated as SI from the French language name Système International d'Unités) is the modern revision of the metric system. It is the world's most widely used system of units, both in everyday commerce and in science. The SI was developed in 1960 from the metre-kilogram-second (MKS) system, rather than the centimetre-gram-second (CGS) system, which, in turn, had many variants. During its development the SI also introduced several newly named units that were previously not a part of the metric system. The original SI units for the seven basic physical quantities were:

Base quantity	Base unit	Symbol	Current SI constants	New SI constants (proposed)
time	second	s	hyperfine splitting in Cesium-133	same as current SI
length	metre	m	speed of light in vacuum, c	same as current SI
mass	kilogram	kg	mass of International Prototype Kilogram (IPK)	Planck's constant, h
electric current	Ampere	A	permeability of free space, permittivity of free space	charge of the electron, e
temperature	Kelvin	K	triple point of water, absolute zero	Boltzmann's constant, k
amount of substance	mole	mol	molar mass of Carbon-12	Avogadro constant N_A

luminous intensity	candela	cd	luminous efficacy of a 540 THz source	same as current SI

The mole was subsequently added to this list and the degree Kelvin renamed the kelvin.

There are two types of SI units, base units and derived units. Base units are the simple measurements for time, length, mass, temperature, amount of substance, electric current and light intensity. Derived units are constructed from the base units, for example, the Watt, i.e. the unit for power, is defined from the base units as $m^2 \cdot kg \cdot s^{-3}$. Other physical properties may be measured in compound units, such as material density, measured in kg/m^3.

Metric systems of units have evolved since the adoption of the first well-defined system in France in 1795. During this evolution the use of these systems has spread throughout the world, first to non-English-speaking countries, and then to English speaking countries.

Multiples and submultiples of metric units are related by powers of ten and their names are formed with prefixes. This relationship is compatible with the decimal system of numbers and it contributes greatly to the convenience of metric units.

In the early metric system there were two base units, the metre for length and the gram for mass. The other units of length and mass, and all units of area, volume, and derived units such as density were derived from these two base units.

Mesures usuelles (French for customary measurements) were a system of measurement introduced as a compromise between the metric system and traditional measurements. It was used in France from 1812 to 1839.

A number of variations on the metric system have been in use. These include gravitational systems, the centimetre–gram–second systems (cgs) useful in science, the metre–tonne–second system (mts) once used in the USSR and the metre–kilogram–second system (mks).

The current international standard metric system is the International System of Units (Système international d'unités or SI) It is an mks system based on the metre, kilogram and second as well as the kelvin, ampere, candela, and mole.

The SI includes two classes of units which are defined and agreed internationally. The first of these classes includes the seven SI base units for length, mass, time, temperature, electric current, luminous intensity and amount of substance. The second class consists of the SI derived units. These derived units are defined in

terms of the seven base units. All other quantities (e.g. work, force, power) are expressed in terms of SI derived units.

Natural units are physical units of measurement defined in terms of universal physical constants in such a manner that some chosen physical constants take on the numerical value of one when expressed in terms of a particular set of natural units. Natural units are natural because the origin of their definition comes only from properties of nature and not from any human construct. Various systems of natural units are possible.

To illustrate this, the ampere, although it is a SI base unit, is a natural unit as it is defined in terms of metres and newtons.

Some other examples are as follows:

- Geometric unit systems are useful in relativistic physics. In these systems the base physical units are chosen so that the speed of light and the gravitational constant are set equal to unity.
- Planck units are a form of geometric units obtained by also setting Boltzmann's constant, the Coulomb force constant and the reduced Planck constant to unity. They might be considered unique in that they are based only on properties of free space rather than any prototype, object or particle.
- Stoney units are similar to Planck units but set the elementary charge to unity and allow Planck's constant to float (i.e. it is an irrational number which has to be determined by experiment).
- "Schrödinger" units are also similar to Planck units and set the elementary charge to unity too but allow the speed of light to float.
- Atomic units (au) are a convenient system of units of measurement used in atomic physics, particularly for describing the properties of electrons. The atomic units have been chosen such that the fundamental electron properties are all equal to one atomic unit. They are similar to "Schrödinger" units but set the electron mass to unity and allow the gravitational constant to float. The unit energy in this system is the total energy of the electron in the Bohr atom and called the Hartree energy. The unit length is the Bohr radius.
- Electronic units are similar to Stoney units but set the electron mass to unity and allow the gravitational constant to float. They are also similar to Atomic units but set the speed of light to unity and allow Planck's constant to float.

- Quantum electrodynamical units are similar to the electronic system of units except that the proton mass is normalised rather than the electron mass.

MATERIALS

Materials technology is a relatively comprehensive discipline that begins with the production of goods from raw materials to processing of materials into the shapes and forms needed for specific applications.

Materials - metals, plastics and ceramics - typically have completely different properties, which means that the technologies involved in their production are fundamentally different. Materials technology is a constantly evolving discipline, and new materials with interesting properties lead to new applications. For example, the combination of different materials into composites gives rise to entirely new material properties. Materials Science is closely related to materials technology. Materials Science is a multidisciplinary field that connects material properties to the material's chemical composition, micro-structure and crystal structure.

The metallurgical industry and the production and processing of materials are very important aspects of Norwegian industry, and also offer significant added value to the economy through the export of products such as aluminium and ferrosilicon. Materials are also of very great importance in the oil and gas industry, such as in providing protection against the corrosion of steel in the marine environment.

Studies in Materials Technology

- Manufacturing and processing of different materials with a focus on metals and chemical reactions.
- Structural and functional properties of materials related to the use, for example. metals, plastics and ceramics.
- Materials that have great significance for energy technology, and how industrial processes and new technologies such as fuel cells and solar cells can help lower emissions of greenhouse gases.
- Refining and recycling metals
- Creating environmentally friendly batteries
- Creating new materials using nanotechnology

The materials are the basis for all new technologies.

Radical materials advances can drive the creation of new products or even new industries, but stable industries also employ materials scientists to make incremental improvements and troubleshoot issues with currently used materials. Industrial applications of materials science include materials design, cost-

benefit tradeoffs in industrial production of materials, processing methods (casting, rolling, welding, ion implantation, crystal growth, thin-film deposition, sintering, glassblowing, etc.), and analytic methods (characterization methods such as electron microscopy, X-ray diffraction, calorimetry, nuclear microscopy (HEFIB), Rutherford backscattering, neutron diffraction, small-angle X-ray scattering (SAXS), etc.).

Besides material characterization, the material scientist or engineer also deals with extracting materials and convering them into useful forms. Thus ingot casting, foundry methods, blast furnace extraction, and electrolytic extraction are all part of the required knowledge of a materials engineer. Often the presence, absence, or variation of minute quantities of secondary elements and compounds in a bulk material will greatly affect the final properties of the materials produced. For example, steels are classified based on 1/10 and 1/100 weight percentages of the carbon and other alloying elements they contain. Thus, the extracting and purifying methods used to extract iron in a blast furnace can affect the quality of steel that is produced.

Ceramics and glasses

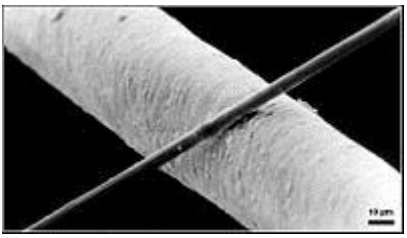
Si_3N_4 ceramic bearing parts

Another application of material science is the structures of ceramics and glass, typically associated with the most brittle materials. Bonding in ceramics and glasses uses covalent and ionic-covalent types with SiO_2 (silica or sand) as a fundamental building block. Ceramics are as soft as clay or as hard as stone and concrete. Usually, they are crystalline in form. Most glasses contain a metal oxide fused with silica. At high temperatures used to prepare glass,

the material is a viscous liquid. The structure of glass forms into an amorphous state upon cooling. Windowpanes and eyeglasses are important examples. Fibers of glass are also available. Scratch resistant Corning Gorilla Glass is a well-known example of the application of materials science to drastically improve the properties of common components. Diamond and carbon in its graphite form are considered to be ceramics.

Engineering ceramics are known for their stiffness and stability under high temperatures, compression and electrical stress. Alumina, silicon carbide, and tungsten carbide are made from a fine powder of their constituents in a process of sintering with a binder. Hot pressing provides higher density material. Chemical vapor deposition can place a film of a ceramic on another material. Cermets are ceramic particles containing some metals. The wear resistance of tools is derived from cemented carbides with the metal phase of cobalt and nickel typically added to modify properties.

Composites



A 6 μm diameter carbon filament (running from bottom left to top right) siting atop the much larger human hair.

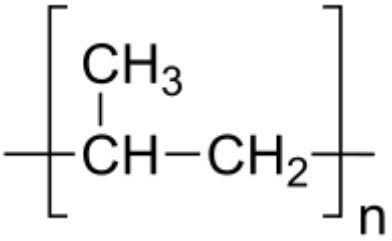
Filaments are commonly used for reinforcement in composite materials.

Another application of materials science in industry is making composite materials. These are structured materials composed of two or more macroscopic phases. Applications range from structural elements such as steel-reinforced concrete, to the thermal insulating tiles which play a key and integral role in NASA's Space Shuttle thermal protection system which is used to protect the surface of the shuttle from the heat of re-entry into the Earth's atmosphere. One example is reinforced Carbon-Carbon (RCC), the light gray material which withstands re-entry temperatures up to 1,510 °C (2,750 °F) and protects the Space Shuttle's wing leading edges and nose cap. RCC is a laminated composite material made from graphite

rayon cloth and impregnated with a phenolic resin. After curing at high temperature in an autoclave, the laminate is pyrolized to convert the resin to carbon, impregnated with furfural alcohol in a vacuum chamber, and cured-pyrolized to convert the furfural alcohol to carbon. To provide oxidation resistance for reuse ability, the outer layers of the RCC are converted to silicon carbide.

Other examples can be seen in the "plastic" casings of television sets, cell-phones and so on. These plastic casings are usually a composite material made up of a thermoplastic matrix such as acrylonitrile butadiene styrene (ABS) in which calcium carbonate chalk, talc, glass fibers or carbon fibers have been added for added strength, bulk, or electrostatic dispersion. These additions may be termed reinforcing fibers, or dispersants, depending on their purpose.

Polymers



The repeating unit of the polymer polypropylene

Expanded polystyrene polymer packaging.

Polymers are chemical compounds made up of a large number of identical components linked together like chains. They are an important part of materials science. Polymers are the raw materials (the resins) used to make what are commonly called plastics and rubber. Plastics and rubber are really the final product, created after one or more polymers or additives have been added to a resin during processing, which is then shaped into a final form. Plastics which have been around, and which are in current widespread use, include polyethylene, polypropylene, polyvinyl chloride (PVC), polystyrene, nylons, polyesters, acrylics, polyurethanes, and polycarbonates and also rubbers which have been around are natural rubber, styrene butadiene rubber, chloroprene, and butadiene rubber. Plastics are generally classified as commodity, specialty and engineering plastics.

Polyvinyl chloride (PVC) is widely used, inexpensive, and annual production quantities are large. It lends itself to an vast array of applications, from artificial leather to electrical insulation and cabling, packaging, and containers. Its fabrication and processing are simple and well-established. The versatility of PVC is due to the wide range of plasticisers and other additives that it accepts. The term "additives" in polymer science refers to the chemicals and compounds added to the polymer base to modify its material properties.

Polycarbonate would be normally considered an engineering plastic (other examples include PEEK, ABS). Such plastics are valued for their superior strengths and other special material properties. They are usually not used for disposable applications, unlike commodity plastics.

Specialty plastics are materials with unique characteristics, such as ultra-high strength, electrical conductivity, electro-fluorescence, high thermal stability, etc.

The dividing lines between the various types of plastics is not based on material but rather on their properties and applications. For example, polyethylene (PE) is a cheap, low friction polymer commonly used to make disposable bags for shopping and trash, and is considered a commodity plastic, whereas medium-density polyethylene (MDPE) is used for underground gas and water pipes, and another variety called ultra-high-molecular-weight polyethylene (UHMWPE) is an engineering plastic which is used extensively as the glide rails for industrial equipment and the low-friction socket in implanted hip joints.

Metal alloys

Wire rope made from steel alloy.

The study of metal alloys is a significant part of materials science. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steels) make up the largest proportion both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid and high carbon steels. An iron carbon alloy is only considered steel if the carbon level is between 0.01% and 2.00%. For the steels, the hardness and tensile strength of the steel is related to the amount of carbon present, with increasing carbon levels also leading to lower ductility and toughness. Heat treatment processes such as quenching and tempering can significantly change these properties however. Cast Iron is defined as an iron–carbon alloy with more than 2.00% but less than 6.67% carbon. Stainless steel is defined as a regular steel alloy with greater than 10% by weight alloying content of Chromium. Nickel and Molybdenum are typically also found in stainless steels.

Other significant metallic alloys are those of aluminium, titanium, copper and magnesium. Copper alloys have been known for a long time (since the Bronze Age), while the alloys of the other three metals have been relatively recently developed. Due to the chemical reactivity of these metals, the electrolytic extraction processes required were only developed relatively recently. The alloys of aluminium, titanium and magnesium are also known and valued for their high strength-to-weight ratios and, in the case of magnesium, their ability to provide electromagnetic shielding. These materials are

ideal for situations where high strength-to-weight ratios are more important than bulk cost, such as in the aerospace industry and certain automotive engineering applications.

Semiconductors

The study of semiconductors is a significant part of materials science. A semiconductor is a material that has a resistivity between a metal and insulator. It's electronic properties can be greatly altered through intentionally introducing impurities, or doping. From these semiconductor materials, things such as diodes, transistors, light-emitting diodes (LEDs), and analog and digital electric circuits can be built, making them materials of interest in industry. Semiconductor devices have replaced thermionic devices (vacuum tubes) in most applications. Semiconductor devices are manufactured both as single discrete devices and as integrated circuits (ICs), which consist of a number—from a few to millions—of devices manufactured and interconnected on a single semiconductor substrate.[14]

Of all the semiconductors in use today, silicon makes up the largest portion both by quantity and commercial value. Monocrystalline silicon is used to produce wafers used in the semiconductor and electronics industry. Second to silicon, gallium arsenide (GaAs) is the second most popular semiconductor used. Due to its higher electron mobility and saturation velocity compared to silicon, its a material of choice for high speed electronics applications. These superior properties are compelling reasons to use GaAs circuitry in mobile phones, satellite communications, microwave point-to-point links and higher frequency radar systems. Other semiconductor materials include germanium, silicon carbide, and gallium nitride and have various applications.

TECHNOLOGY

Technology ("science of craft", from Greek τέχνη, techne, "art, skill, cunning of hand"; and -λογία, -logia) is the collection of techniques, skills, methods and processes used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation. Technology can be the knowledge of techniques, processes, and the like, or it can be embedded in machines which can be operated without detailed knowledge of their workings.

The human species' use of technology began with the conversion of natural resources into simple tools. The prehistoric discovery of how to control fire and the later Neolithic Revolution increased the available sources of food and the invention of the wheel helped humans to travel in and control their environment.

Developments in historic times, including the printing press, the telephone, and the Internet, have lessened physical barriers to communication and allowed humans to interact freely on a global scale. The steady progress of military technology has brought weapons of ever-increasing destructive power, from clubs to nuclear weapons.

Technology has many effects. It has helped develop more advanced economies (including today's global economy) and has allowed the rise of a leisure class. Many technological processes produce unwanted by-products known as pollution and deplete natural resources to the detriment of Earth's environment. Various implementations of technology influence the values of a society and new technology often raises new ethical questions. Examples include the rise of the notion of efficiency in terms of human productivity, and the challenges of bioethics.

Philosophical debates have arisen over the use of technology, with disagreements over whether technology improves the human condition or worsens it. Neo-Luddism, anarcho-primitivism, and similar reactionary movements criticise the pervasiveness of technology in the modern world, arguing that it harms the environment and alienates people; proponents of ideologies such as transhumanism and techno-progressivism view continued technological progress as beneficial to society and the human condition.

Until recently, it was believed that the development of technology was restricted only to human beings, but 21st century scientific studies indicate that other primates and certain dolphin communities have developed simple tools and passed their knowledge to other generations.

The use of the term "technology" has changed significantly over the last 200 years. Before the 20th century, the term was uncommon in English, and usually referred to the description or study of the useful arts. The term was often connected to technical education, as in the Massachusetts Institute of Technology (chartered in 1861).

The term "technology" rose to prominence in the 20th century in connection with the Second Industrial Revolution. The term's meanings changed in the early 20th century when American social scientists, beginning with Thorstein Veblen, translated ideas from the German concept of Technik into "technology." In German and other European languages, a distinction exists between technik and technologie that is absent in English, which usually translates both terms as "technology." By the 1930s, "technology" referred not only to the study of the industrial arts but to the industrial arts themselves.

In 1937, the American sociologist Read Bain wrote that "technology includes all tools, machines, utensils, weapons, instruments, housing, clothing, communicating and transporting devices and the skills by which we produce and use them."[6] Bain's definition remains common among scholars today, especially social scientists, but equally prominent is the definition of technology as applied science, especially among scientists and engineers, although most social scientists who study technology reject this definition. More recently, scholars have borrowed from European philosophers of "technique" to extend the meaning of technology to various forms of instrumental reason, as in Foucault's work on technologies of the self (techniques de soi).

Dictionaries and scholars have offered a variety of definitions. The Merriam-Webster Learner's Dictionary offers a definition of the term: "the use of science in industry, engineering, etc., to invent useful things or to solve problems" and "a machine, piece of equipment, method, etc., that is created by technology." Ursula Franklin, in her 1989 "Real World of Technology" lecture, gave another definition of the concept; it is "practice, the way we do things around here." The term is often used to imply a specific field of technology, or to refer to high technology or just consumer electronics, rather than technology as a whole. Bernard Stiegler, in Technics and Time, 1, defines technology in two ways: as "the pursuit of life by means other than life," and as "organized inorganic matter."

Technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value. In this usage, technology refers to tools and machines that may be used to solve real-world problems. It is a far-reaching term that may include simple tools, such as a crowbar or wooden spoon, or more complex machines, such as a space station or particle accelerator. Tools and machines need not be material; virtual technology, such as computer software and business methods, fall under this definition of technology. W. Brian Arthur defines technology in a similarly broad way as "a means to fulfill a human purpose."

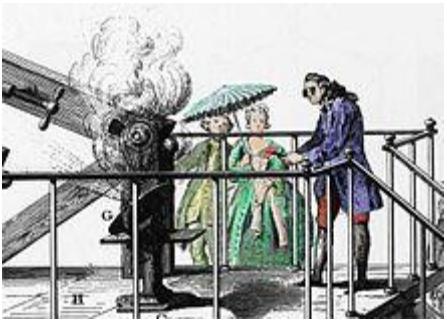
The word "technology" can also be used to refer to a collection of techniques. In this context, it is the current state of humanity's knowledge of how to combine resources to produce desired products, to solve problems, fulfill needs, or satisfy wants; it includes technical methods, skills, processes, techniques, tools and raw materials. When combined with another term, such as "medical technology" or "space technology," it refers to the state of the respective field's knowledge

and tools. "State-of-the-art technology" refers to the high technology available to humanity in any field.

The invention of integrated circuits and the microprocessor (here, an Intel 4004 chip from 1971) led to the modern computer revolution.

Technology can be viewed as an activity that forms or changes culture.[14] Additionally, technology is the application of math, science, and the arts for the benefit of life as it is known. A modern example is the rise of communication technology, which has lessened barriers to human interaction and as a result has helped spawn new subcultures; the rise of cyberculture has at its basis the development of the Internet and the computer.[15] Not all technology enhances culture in a creative way; technology can also help facilitate political oppression and war via tools such as guns. As a cultural activity, technology predates both science and engineering, each of which formalize some aspects of technological endeavor.

Science, engineering and technology



Antoine Lavoisier conducting an experiment with combustion generated by amplified sun light

The distinction between science, engineering, and technology is not always clear. Science is systematic knowledge of the physical or

material world gained through observation and experimentation. Technologies are not usually exclusively products of science, because they have to satisfy requirements such as utility, usability, and safety.

Engineering is the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science. The development of technology may draw upon many fields of knowledge, including scientific, engineering, mathematical, linguistic, and historical knowledge, to achieve some practical result.

Technology is often a consequence of science and engineering, although technology as a human activity precedes the two fields. For example, science might study the flow of electrons in electrical conductors by using already-existing tools and knowledge. This newfound knowledge may then be used by engineers to create new tools and machines such as semiconductors, computers, and other forms of advanced technology. In this sense, scientists and engineers may both be considered technologists; the three fields are often considered as one for the purposes of research and reference.

The exact relations between science and technology in particular have been debated by scientists, historians, and policymakers in the late 20th century, in part because the debate can inform the funding of basic and applied science. In the immediate wake of World War II, for example, it was widely considered in the United States that technology was simply "applied science" and that to fund basic science was to reap technological results in due time. An articulation of this philosophy could be found explicitly in Vannevar Bush's treatise on postwar science policy, Science – The Endless Frontier: "New products, new industries, and more jobs require continuous additions to knowledge of the laws of nature ... This essential new knowledge can be obtained only through basic scientific research." In the late-1960s, however, this view came under direct attack, leading towards initiatives to fund science for specific tasks (initiatives resisted by the scientific community). The issue remains contentious, though most analysts resist the model that technology simply is a result of scientific research.

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