Metrication is SUCCESSFUL

Metrication is SUCCESSFUL because it is:

Simple

The modern metric system, formally known as the International System of Units (SI), is the simplest and easiest-to-use system of measurement ever devised. In fact the metric system is the only system of measurement ever devised. All previous measuring methods were just a hodge-podge of randomly generated local measures.

Unique

The metric system is unique. Never before, has there been a method of measurement that has all the positive benefits as SI.

Coherent

The metric system uses the same decimal nature as our number system, and it uses the same mathematical rules and symbols that we use for the mathematic of numbers

Capable

The metric system is capable of measuring anything in any trade, profession, or other human activity. The metric system has no limitations. For example, you might measure the distance from here to the door in metres, the distance from between your home and your work in kilometres, the width of your little finger nail in millimetres, the diameter of the hairs on your head in micrometres, and the size of one of your cells in nanometres. Why stop there? With the SI prefixes, there is more than enough flexibility to measure from the size of sub-atomic particles – the diameter of an electron is about 6 femtometres – to the size of the whole Universe – the diameter of the Universe, as observed by the world's best telescopes, is about 250 yottametres.

Equitable

The key argument for using the metric system is that it is fair to all concerned. This has been a demand placed on all measuring methods from the beginning of recorded history.

For example, in the King James version of the Bible there is the instruction:

> *'Just balances, just weights, a just ephah, and a just hin, shall ye have ... ' (Leviticus 19:36).*

As the book of Leviticus is one of the earlier books of the Bible, we can assume that these demands for honest weights and measures have been around for at least 7000 years.

The Koran (written between 610 and 632) says:

> *'Woe to those who give short weight! Who when they measure against others take full measure; but when they measure to them or weigh to them, diminish!" (Koran Sura 83).*

Supported

The metric system, as the International System of Units (SI) is supported by international treaties and by national legislation. There are no international differences; SI is a fully maintained world standard maintained by the 'TREATY OF THE METRE'. SI is a legal method of measuring in every country in the world.

System.

The metric system is a system of units. SI was designed and planned with each unit as part of the whole plan. This is why it is called the 'International System of Units'. SI is a system that ensures that quantities and units are uniform in concept and style. SI is a system that reduces or eliminates measuring confusion.

Fundamental

SI is now fundamental to all measurements, both old and new. All old measures, even in the USA, are now defined with SI units as their basis. For example:

- 1 inch = 25.4 millimetres (exactly)
- 1 pound = 453.592 37 grams (exactly)

The inch and the pound have no other definitions except in terms of metric system units. The metric system is now the sole system used as the basis of international trade.

Unique

There has never been a measuring system like SI – never in the history of the world.

Because SI was designed with each unit as part of a whole plan there is only one unit for each physical quantity.

SI uses quantities and units that are uniform in style so conversions are not necessary.

Legal

Legislation in every nation in the world supports the metric system.

SI is often the sole measurement method recognised by governments.

International agreements legally support the metric system so that contracts written in SI are valid across borders.

Let me spell it out for you:

Metrication is

S - U - C - C - E - S - S - F - U - L

10 ways to promote metrication

Act metric, encourage metric, learn metric, live metric, plan metric, promote metric, support metric, teach metric, think metric, and write metric.

Act metric

Metricate your own life. Get to know your height in metres, your body mass in kilograms, the width of your little fingernail, and the width of your hand. Have metric thermometers and do metric cooking, etc.

Encourage metric

Gently tell others of the benefits of 'going metric'. Get the article, '*What is metrication*' from http://www.MetricationMatters.com/articles.html to help you with ideas for this.

If you state a metric measurement and some asks you 'What is that in inches (cups, etc.)?' respond with a description rather than a conversion to a pre-metric measure:

> *'I found a caterpillar that was 95 millimetres long!'*
>
> *'What's that in inches?'*
>
> *'Oh, about as wide as your hand.'*

Learn metric

Find out as much as you can from others who have successfully completed a metrication transition. This includes other people, other groups, other, companies, other industries, and other nations – all of these have metrication ideas, stories, and tactics you can use. You might find the '*Metrication timeline*' from http://www.MetricationMatters.com/articles.html helpful to put your metrication ideas into an historical perspective.

Download the SI Brochure from the BIPM in Paris — it's free. Get the English language edition from http://www.bipm.org/en/si/si_brochure/general.html

This brochure, '*The International System of Units (SI)*' is the essential reference for anyone who wants to use the modern metric system correctly.

Live metric

Where you have a choice, buy metric products, avoid old measures, and especially avoid dual measures.

Plan metric

Promote metric in your job, to your co-workers, your boss and in any volunteer activities you do.

Promote metric

Join the United Kingdom Metric Association (UKMA) or join the United States Metric Association (USMA) as an individual member. Ask your employer to join as a corporate member. Go to http://lamar.colostate.edu/~hillger/ for resources and ideas to get started with this.

Support metric

Get a CMS or CAMS certification from the USMA to give substance to your metric opinions. Get details from http://lamar.colostate.edu/~hillger/cms.htm

Volunteer to help the USMA in some capacity (e.g., become an expert on FPLA legislation, review upcoming legislation for pro/anti metric content, etc.)

Teach metric

Volunteer to coach or tutor at local science fairs or your children's schools.

Think metric

Seek out, and report by writing letters to the publication or organisations responsible. These reports are often highly appreciated by the company that receives them as valuable consumer feedback. Write about:

- errors in product specifications;
- errors on packaging labels;
- failures to comply with metric laws; or
- misuse of metric notation.

Write metric

Write letters, email, and articles that are polite and to the point. Angry, long or abusive letters are, at best, ignored, and at worst do the opposite of what they intend. Post any letters you write to the USMA listserver (at http://lamar.colostate.edu/~hillger/listserv.htm), to provide ideas and encouragement to others. Write:

- to editors promoting metrication and send them to trade journals of your profession;
- to elected officials supporting metric legislation and denigrating anti-metric legislation;
- to manufacturers politely chiding them when they do not use metric;
- to manufacturers praising them when they produce hard-metric products and use metric notation properly. Also write to them with helpful criticisms about the correct use of SI units and SI symbols;
- to manufacturers when you find products that don't comply with fair packaging and labelling laws requirements for metric units. In fraudulent cases, write to the appropriate state authorities;
- to media supporting metrication and explaining its benefits;
- to media praising them when they use metric notation properly, and with helpful criticisms about the correct use of SI units and SI symbols; and
- your own web site for a hobby that interests you and promote metric on it ('Heavy Metric Metal!' or 'Metric Home Brewers').

Arguments and responses

You will find it helpful to prepare some responses to counter arguments against the metric system. To help you with this, I surfed the internet to find as many anti-metrication views as I could. I found a lot, almost all of them were from the UK and the USA, but many of them were very repetitive. I kept collecting until the repetitions became too boring.

At that point, I had collected 138 negative views about the metric system. I then grouped them into some sort of order so that I could find them easily, and wrote a response for each one. The original arguments are as I found them except for a little light editing when the writers had obviously let their emotions take over from their spelling, grammar, and courtesy skills. I also tried to reduce repetition, but I know I didn't get them all, so there is still a little repetition.

I make no apology for the length of this document – I was thorough. This list is idiosyncratic to me. I have had direct experience farming beef cattle, cereals, dairy, poultry, sheep, and wool. I have also worked in home building, industrial construction, recycling, science education, and scientific research. Indirectly, I have worked with ballet dancers, bricklayers, carpenters, electoral counters, forensic scientists, furniture makers, mechanical engineers, opera singers, piano makers, police, plumbers, prisoners and prison officers, spinners, teachers, top-makers, weavers, and welders.

One observation that I made from my various experiences is that the change to metric goes much smoother and faster if you choose millimetres as your small unit and avoid the use of centimetres altogether. I don't fully know why this is so, although I suspect that it is direct result of eliminating fractions from calculations. However, having carefully observed metrication in many industries and having carefully considered this question for many years, I am convinced that metrication programs that choose millimetres go much more smoothly – and rapidly – than those that choose centimetres. For a full discussion of this topic, see the article, *centimetres or millimetres — which will you choose?* at: http://www.metricationmatters.com/docs/centimetresORmillimetres.pdf

I am indebted to the generosity of members of the United Kingdom Metric Association, the United States Metric Association, and to many others for their thoughts on many of these responses.

138 arguments against SI

The 138 arguments that I collected are grouped under these nine headings:

- There are better ways than metric (41 arguments)
- Other people use old measures – so old measures are OK (38 arguments)
- It’s too hard to change (17 arguments)
- It is old - therefore it is good (10 arguments)
- Metric is foreign (9 arguments)
- There's nothing wrong with the old methods (8 arguments)

- We should have freedom of choice in measurement (7 arguments)
- Old measures are natural (6 arguments)
- I don't want to change my mind (2 arguments)

There are better ways than metric (41 arguments)

Argument: Any method of measurement is OK. We don't need new measures.

Response: This is an interesting observation because the old ways are not a 'single method of measurement' – they are a random collection of all the methods of measurement ever used by anyone in the world. Our major religious documents refer to cubits, ephahs, and hins; our clocks refer to ancient Babylonian hours and minutes; and our shoe sizes are measured in barleycorns. One of the main goals of metrication is to simplify the measures we use for our daily life. A key part of that simplification is to reduce the number of measuring units from the many hundreds of thousands of old units to the twenty-nine units of the International System of Units that is universally known by the symbol SI.

Argument: It is an advantage for children to learn two sets of measurements.

Response: This argument contradicts the truth – it is a major disadvantage for children to have to learn two sets of measurements, and it is a major waste of their time. Learning the old measures takes schools about an hour each day, for about 200 days in a school year, and for anything up to twelve years of schooling. At the end of this process, very few people claim to be competent and confident in their use of these old measures. On the other hand, educational research, in the USA, suggests that teaching of measurement can be reduced by about 90 % if only the metric system is taught in schools.

Argument: We should use both measurements. We should use be able to use dual methods at the same time.

Response: Valerie Antoine, Executive Director of the United States Metric Association says, 'We can't afford to use two measurement systems. U.S. companies that export, have to keep two sets of records, one for domestic products and one for exported products. It costs more for them to manufacture goods, therefore it costs American people more to buy them.'

Argument: Now that we have calculators, we don't need to change to metric to save time in calculations.

Response: Unfortunately, calculators are not very good for handling fractions other than decimals. Calculators are almost all designed to handle decimal numbers easily. This suits the metric system because, in SI, all factors between multiples are either 10, 100 or 1000. In fact, for many people, and for many purposes, such as in building and engineering, their only multiple is 1000.

Argument: On the farm, we are used to a range of units. Some examples are: inches, links, feet, yards, rods, chains, furlongs, and miles.

Response: This is not a complete list of old farm measures – there are hundreds, maybe thousands of other old units that have been used on farms. SI, with only 29 units, replaces all of these old measures. For example, measuring lengths on a farm

can all be done using only three SI units – millimetres, metres, and kilometres all related by one multiple – 1000. Who would prefer to use the old mismatched collection of Babylonian, Egyptian, French, Greek, Roman, and Syrian measurements with strange multiples such as: 3, 5 1/2, 7.92, 12, 15 1/2, 22, 40, 72, and 80?

Argument: At sea, we like to use a range of units, such as fathoms, feet, inches, leagues, nautical miles, and yards?

Response: In SI, all of these are replaced with millimetres, metres, and kilometres – only three units – simpler is safer.

Argument: As mechanical engineers, we already enjoy the advantages of decimal numbers because we regularly use decimal inches.

Response: And civil engineers use decimal feet, and land surveyors use decimal chains by having 100 links in their chains. However, like many old methods of measurement, there is no coordination between these different decimal methods. There is no system that allows a mechanical engineer to readily understand the work of a civil engineer, or a land surveyor, and vice versa. The metric system, on the other hand, is well adapted to this. A mechanical engineer, working in millimetres and metres, can readily comprehend the metres and kilometres used by a civil engineer.

Argument: Metrication is a scam to benefit other countries that think that conformity is a good thing – it's not.

Response: Conformity in standards, technology, and measurement saves all manufacturers millions of dollars every day because traders anywhere in the world can trust the measurements made by other people anywhere else in the world. In addition, people from SI nations have no need for training to cope with overseas developments and technology; only people from the USA have to face these issues, and these additional costs.

Argument: SI is changing all the time.

Response: True, it's getting better all the time. For example, since 1790, the definition of the metre, the key unit of the metric system, has been changed several times. At no time has the length of the metre changed, but its definitions has got better each time so that modern measurements can be confidently undertaken. The original metre was good enough for land measures in the late 18th century, but these days with viruses and bacteria measured to fractions of a nanometre we need the precision that we can achieve by defining the metre in terms of the speed of light. However, to repeat the main point of this response, the changes in the definition of the metre has never resulted in a change in the length of the metre.

Argument: Any methods would be OK. Units of measurement are only as good as those who use them.

Response: Any system of measurement is essentially a common tool that we have all agreed to use. Its effectiveness depends on the ease of use of the tool, and on the ability of users to employ that tool. By having a tool that is easy to use, you reduce the amount of energy needed to use it effectively and you increase the productivity

of all of the tool's users. By using SI as our measuring tool we all gain in accuracy and precision as we reduce costs.

Argument: SI is scientific and not suitable for everyday living.

Response: Do you regard drinking Coca-Cola that comes in litres and millilitres as a scientific activity? Do you regard driving your metric car as scientific; all cars have been designed and built using metric units, only, since the mid 1970s? There are about 7000 million people in the world and 96 % of them use the metric system for everything they buy, sell, or measure every day – and very few of them are scientists. The other 4 % of people live in the USA.

Argument: The English System is based on one of the most basic measurement notions, that of halving and doubling. There are 16 ounces to a pound, which means that if you cut your quarter-pounder in half and then in half again, you have an ounce. Similarly, half of a quart is a pint, half of that a cup and if you halve that three more times, you have a fluid ounce. Half of that is a tablespoonful. Double a quart twice and you get a gallon.

Response: This is a nice thought and about three thousand years – so far – has been spent trying to implement it. The net result is that in the world, we now have several different ounces, several different pints, several different quarts, several different cups, several different teaspoons, several different tablespoons, several different quarts, and several different gallons. I wish you well if you decide to promote a new halving and doubling method.

Argument: The Fahrenheit temperature scale is better than Celsius because its got more degrees on it. This makes it more accurate.

Response: It is a curious thing that human sensitivity to temperature is about one degree Celsius; humans cannot detect differences smaller than this. Of course, because a degree Celsius is a metric measure, and therefore decimal, you could simply use tenths of degrees, or even millidegrees Celsius, if you require more precision.

Argument: I am used to the old measures; I know what 68 °F feels like.

Response: And you know what 20 °C feels like too – because they're the same.

Argument: The public are not smart enough to handle metric measures.

Response: Every day, in every way, 96 % of the world's people use the metric system. Only the people of the USA have not yet (openly) chosen the simplicity and ease of using the metric system.

Argument: The Imperial System is more practical because its units developed from use – rather than by Committee.

Response: Although mathematicians, scientists, and technicians designed the decimal nature and the logical coherence of the metric system, the measures that they chose were based on practical human-scale measures. For example: your thumb nail is about 1 mm thick; your little finger nail is about 10 mm wide; and your hand is about 100 mm wide.

Argument: Let's go back to the 'imperial' weights and measures, i.e. the good old-fashioned pounds, pints, inches, ounces, and feet.

Response: They may be old-fashioned, but are they good? Do you really support measuring methods that are uncoordinated, difficult to use, and prone to errors?

Argument: The USA, quite rightly, should never have anything to do with the metric system.

Response: the USA has been deeply involved with the development of the metric system for a very long time. The USA is a signatory of the Metric Convention of 1875 and it is a member state of the International Bureau of Weights and Measures, set up under that convention?

Argument: The metric system is just a rip-off. Metric units are very close to the old ifp units: a metre is really just a long yard, a litre is about the same as a quart, and so are a tonne and a ton.

Response: What you say is true. In all methods of measurement, there are sizes that are convenient for humans to handle, but it doesn't matter how you measure them. SI was designed to have many values similar to the old ones to make it more convenient to use and more acceptable to the conservatives as it was adopted in each nation.

Argument: The metric system is not a coherent stable whole (it has internal contradictions and it is in flux) and the US does not use the 'Imperial System'.

Response: There are many more internal contradictions and fluxions with old measures than there are with SI. Until the foot was defined by metric measures, for example, its length was in a constant state of variation. Compare this with the metre that has been a consistent length since 1799.

Argument: The metric system is too complicated. It uses the speed of light just to define a metre – who can understand that – everybody could understand what a foot is.

Response: The second part of this argument is simply untrue. Very few people know that a foot was defined as 304.8 millimetres in 1959; and even less know that a foot was defined (in the USA) as (36/39.37)/3 metres in 1893. The first part of the argument is also untrue; because the speed of light is the standard for the metre, any competent laboratory anywhere in the world can check the length of the metre. Where in the world is the world standard foot?

Argument: The feet, inches and miles – used by the USA – are good enough that they could be used as the world standard.

Response: The USA does not have a standard foot, a standard inch, or a standard mile, because all units in the USA are defined in terms of metric standards; a foot is defined as 304.8 millimetres exactly, an inch is defined as 25.4 millimetres exactly, and a yard is defined as 914.4 millimetres exactly. There is no such thing as a 'Standard Yard' or a 'Standard Pound' in the USA anymore. The Mendenhall Order superseded the old definitions in 1893, when they were replaced by metric definitions. Currently, all measurement in the USA (such as feet, inches, yards and pounds) totally depends on the modern metric system; the USA is currently using a second hand metric system.

Argument: The metric system is too rigid; there aren't enough units to be able to choose the best unit for the job you are doing.

Response: SI uses only one unit, the metre, to measure from the diameter of an electron, at about 6 femtometres, to the diameter of the known universe, at about 200 yottametres; both of these are measured in metres with prefixes being chosen to suit the different sizes. Old measures have trouble measuring these extreme sizes in any understandable way without changing the names and definitions of the units.

Argument: The metric system seems to always come back to the old values. Look how often they use 300 mm - why not say a foot? What about 30 mL; why not use an ounce? In buildings, they use 1200 mm all the time; what's wrong with four feet? Metric measures are constantly shifting toward the old units.

Response: The pyramids were built using a 'Royal Cubit' of close to 600 millimetres. If you place two of these together, you get a building module of 1200 millimetres. Builders throughout history have chosen to build with 'building modules' that were convenient enough to handle but not so small that they required too much measuring, cutting, or fixing. In the olden days, you could get a two foot wallboard, a three foot wallboard, a four foot wallboard, a four foot six inch wallboard; and all of these came in multiple lengths; this range of sizes led to increased costs. A wallboard of 2400 mm by 1200 mm has the additional advantage of having its length to width in the ratio of 2:1, which means that sheets can be fitted together in several efficient ways to cover many different areas. A 2400 mm by 1200 mm sheet is about as big as one person can handle so it has become a very common size in building all around the world, and it has been a convenient size for a long time, however it was measured.

Argument: The metric system violates the natural human requirement of subdivision into 3, 4, 6, 8, ... parts. The metric system is also inadequate for the subdivision of the circle, for the 24 hours in the day, the 12 months in the year, and the 32 points of the compass. All these requirements are met by changing the number base from 10 to 12; we need a duodecimal system rather than a decimal system.

Response: Using duodecimal measures, based on twelves, would come at the expense of not having a measurement system that matched the numbers we use for counting and calculating things. You are advocating that we have measures based on twelves and twelfths, while at the same time we count in tens and tenths. I think that thousands of years experience, since Babylonian times, have shown that having multiple number systems at the same time leads to multiple confusion, with its associated corruption. However, having said that, we still have the remnants of many duodecimal methods that have been tried over the years; most of them failed. The fact that there are 12 inches in a foot is a notable example, and this is a remnant of a Roman attempt at using a duodecimal measuring method, 2000 years ago. The word 'inch' comes from the Latin word 'uncia' and this simply meant 'a twelfth'. Coincidentally, the Latin word 'uncia' also gave us the word 'ounce' because there were 12 'uncia' in a 'libra' in ancient Rome.

Argument: The old imperial measurements worked very well. They were easy to imagine but they were sometimes difficult to use in calculations. This didn't really matter because few people did many calculations.

Response: Few people did many calculations with old measures because the calculations were often too difficult. Now, with SI, calculations are easy and even easier if you use your calculator. SI is demonstrably easier to use in day-to-day commercial and technical calculations because all SI measurements are automatically expressed in terms of a single multiple in decimal form. To test this idea try figuring how many 5 ½ ounces bottles of perfume you can get from a nine-gallon container, and then calculate how many 150 millilitre bottles you could get from a 40 litre container.

Argument: The USA has already set world standards like the 55 gallon oil or chemical drum that is used everywhere in the world.

Response: This drum was designed to hold 200 litres of oil or chemical with a small air space above the level of the liquid. Of interest is the fact that the 200 litre drum became 55 gallons in the USA and 44 gallons in the UK because of the different gallons used by these two nations.

Argument: The old ways of measuring are not bad. Proponents of SI should not attack them. Just because the metric system is better does not mean that USA measures are bad. I'm tired of the constant diatribe against the old methods.

Response: Think about the Model T Ford or an IBM 286; these weren't bad either. However, the old ways of measuring are bad in that they are inefficient, complicated, and expensive. Some of the old ways were so bad that most people could not use them. They were riddled with tricks and devices that favored traders over members of the public. In many cases, the old methods were, and still are, deliberately designed and used to defraud the public.

Argument: The old ways were not inefficient.

Response: Every individual, every group, every company, and every nation that has ever changed to metric measures for long enough to get used to them, has always remained with metric; none of them have ever gone back to the old ways permanently. The most notable example of this was when France reverted to old measures. Following numerous protests about the new system of measurement the French government of Napoleon decided to go back to the use of the old measuring words (such as the aune, the boisseau, the livre, and the toise) when he reintroduced '*mesures usuelles*'. As this was done, the old measuring words were given new definitions based on the definitions used in the metric system (such as the metric aune, the metric boisseau, the metric livre, and the metric toise). This led to total confusion in measurement in France and eventually led to demonstrations, riots, and even deaths. The Napoleonic measuring confusion lasted for about a generation. The metric system was reinstated as the sole means of measurement, in 1840, and its position in France has not been seriously threatened since then.

Argument: Only learning multiples of 10, and nothing else, would dumb down the school system because kids would learn less mathematics.

Response: Fractions will still be part of the school arithmetic curriculum. There is nothing at all, in any part of the metric system, against the teaching of fractions. They are just not used as often in measuring as previously. People will still think and talk about things such as half a litre of drink or a quarter kilogram of bacon. However, experience with children has shown that once they learn multiples of 10, they readily master metric measurements. In all other countries, other than the USA, learning metric measures actually helps kids learn the rest of the mathematics curriculum.

Argument: The whole metric system, which seems to be rational on paper, is irrational in practice. For example, the gram was first defined as a cubic centimetre of water. This was too small, so they switched to a kilogram and defined that, not as 1000 grams of water, but in terms of a platinum cylinder kept in a suburb of Paris. Am I supposed to go to Paris whenever I want a kilogram of cheese?

Response: Definitions of units are necessary to give a system of measuring units the legal authority to maintain its integrity all over the world and through time. The original designers of the metric system had a motto, 'A tous les peuples; a tous les temps' and this translates as, 'For all people; for all time'. You don't need to go to Paris (although it might be rather pleasant to do so) when you want a kilogram of cheese because your government has a copy of the standard kilogram and your government makes further copies for the use of your local weights and measures inspectors. When you buy your kilogram of cheese the amount you get is directly traceable all the way back to the standard kilogram in Paris. Even if you order a pound of cheese, the amount you get can be traced back to the international standard kilogram in Paris. There are no international standards, anywhere in the world, for the pound, the ounce, the, hundredweight, and the ton, other than the kilogram in Paris. By the way, have you had trouble with the definition of a yard in the past – did you toddle off to London every time you wanted a yard of fabric?

Argument: There are more natural number choices rather than 10. Twenty and twelve are better choices.

Response: Many different numbers have been chosen as bases for measuring methods in the past. Twenty has been used, as has twelve, both with limited success. A notable example was English currency. Before they 'went decimal', they divided pounds into 20 shillings, the shillings into 12 pence, and the pennies into 4 farthings. They used twenty, twelve, and four as the basis of different parts of their money system. Now that the change to decimal currency has been made there is no demand for them to go back to these old methods. Other factors have also been tried; we still have remnants of an old method from Babylon, in Iran, that gives us 60 seconds in a minute, sixty minutes in an hour and twenty-four hours in a day.

Argument: Today, the meter is defined as the length of the path travelled by light in a vacuum in 1/299,792,458th of a second. Isn't that a handy rule of thumb when buying a string of sausage?

Response: I've never thought to order a metre of sausages before, thank you for the idea. I suggest that you buy your sausages by the kilogram and leave the precision offered by a definition based on the speed of light to scientists and technicians such as surveyors. They need the extra precision for their work – you

don't for your kilogram of sausages. When you next make a length measurement with (say) a metre stick, you will have the full assurance that you are not being cheated because you know that the measuring authorities have calibrated your metre stick, to an appropriate level, down to the last 1/299,792,458-th of a second. By the way, have you had trouble with this definition of a yard before? Remember that the yard is defined as a fraction (0.914 4) of the metre so the yard, too, is defined in terms of the length of the path travelled by light in a vacuum in 1/299,792,458th of a second.

Argument: We can understand the old ways better than metric.

Response: Would you rather use minims, fluid drams, ounces, pints, quarts, gallons, bushels, hogsheads, US ounces, US dry pints, US dry quarts, US dry barrels, cranberry barrels, petrol barrels, wine gallons, ale gallons, etcetera, and so on, and so forth? Alternatively, could you rather use litres – with millilitres and kilolitres? Hardly anyone, including measurement specialists called metrologists, ever understood all of the old ways of measuring – they were far too complicated. As an example, think of a common rural problem. How big does a rainwater tank need to be to hold a year's supply of water from a roof? In metric, this is easy; each millimetre of rain on each square metre of roof causes a litre of water to flow into the tank. Using old measures, this calculation is so difficult that few ever attempted it; it involved conversions of fractions of inches of rainfall into feet to find the number of cubic feet of water that could be converted into gallons.

Argument: We know we are getting good value when we shop using the old measures.

Response: Most of the shopping we do is done by a simple visual examination. We choose the package the same size as the last one we bought. We trust the government regulators and inspectors to make sure that the amount of goods placed in each package meet the legal standards. If we can't see the package, we ask for one that's about 'Yay' big. In fact, it is quite rare for any actual measurement to take place during a purchase for your normal requirements.

Argument: Metric measurements aren't easy to calculate just because they're based on multiples of 10. One-third of a kilometre, for example, can be rounded to 333.333 meters, but that's not precise. A third of a mile, however, is exactly 1,760 feet.

Response: It is rarely necessary to divide kilometres into three. However, if you have to divide a kilometre into thirds, you simply choose your level of precision by adding more threes; for example 333.333 is accurate to the nearest millimetre. On the other hand: what is 1/3 gallon? What is 1/3 pound or 1/3 ounce avoirdupois? What is 1/3 chain or 1/3 furlong? What is the logic and precision of the widespread practice of dividing old units in decimals? What is the meaning of 5.6 miles, 3.7 ft, 5.8 gallons, etc.? I know very well that 5.62 km is equal to 5620 metres, but it is much more difficult to understand that 5.62 miles is 5 miles, 48 chains, 13 yards, 0 feet, and 7 13/64 inches.

Argument: We should have a rich and diverse choice of measurement.

Response: We have had a rich and diverse range of measurements available to us and all it did was cause inefficiency and confusion. Don't forget that our

measurement methods underpin almost everything that we do. From the time we rise each morning to the time we go to bed, a range of measurements governs most of the moves we make. We need measurements to be as simple as possible so that they do not impinge too much onto the more enjoyable activities in our lives.

Argument: Why do we have to use a base-10 system? Why can't we use a base-12 system? Tens only divide into twos and fives, but twelves divide into twos, threes, fours, and sixes.

Response: It is true that twelves give a better range of factors for stacking – so we should use a base-12 system for that – stacking. However, because we use a decimal number system, a decimal number is better for anything that requires calculations, and for this it is better to use a base-10 system. After each attempt at using other number bases, the decimal system returned and it became the most widely adopted. From time to time, some people will try to resurrect these old number systems. Curiously, everyone who does this always starts with the decimal numbers as the basis for their 'new' methods.

Argument: With metric, things have to be done in tens; we can't get a dozen eggs any more!

Response: To say that 'things have to be done in tens' is nonsense. Eggs pack well in dozens that are 6 x 2, and bottles of wine pack well in dozens that are 4 x 3; and tennis balls work OK in threes. However, tens are best when you have calculations to do. Measurements often need to be added, subtracted, multiplied, or divided, so tens are always best for this purpose.

Argument: You have to be clever with numbers to be able to use the metric system. In the old days, everyone could understand feet and inches.

Response: Very few people could say that they were experts on the old methods of measurement – the old ways were too complex and too variable. Many people with a little training can and do claim to be expert users of the metric system. This could be one of the sticking points in a metrication program; people don't want to learn another complicated method like the old one they had to learn, and they don't yet have enough experience to know the simplicity of SI.

Argument: As a day-by-day, visit-the-timber-yard, ordinary sort of bloke, I do seriously prefer inches, feet and yards to mms, cms and ms. These old measurements remind me of thumbs and feet and paces. They relate to the familiar. I have a mental picture of what they are, and so, still, do many other people I encounter. That scarcely makes us Luddites!

Response: Measure yourself – your thumb is 25 millimetres wide; your foot is 300 millimetres long; your pace is 750 millimetres; your thumb nail is 0.5 millimetres thick; your little finger nail is 10 millimetres wide; and it is a metre from the ground to your hip. As you become familiar with metric measures, your tasks will become easier and easier. You might then describe yourself as 'a day-by-day, visit-the-timber-yard, metric sort of bloke'. Good luck!

Other people use old measures – so old measures are OK (38 arguments)

Argument: All the sports are reported in feet and pounds.

Response: In a single country such as the USA, sports can be reported in old measures, but SI makes the sports news, sports travel arrangements, and sporting exchanges understandable between all nations. For example, to describe the Olympic Games the metric system is the only way to communicate the sports results with the 96 % of the world population who use SI as their daily measurement language. Athletes know that they have to operate with SI units when it comes to international competition, so they learn how to do this early in their competitive career.

Argument: Babies are measured in pounds and ounces. Have a look at the Birth Notices in the local paper.

Response: The newborn baby's mass is measured in kilograms. The medical staff then carefully records the baby's mass in kilograms in case the child becomes ill; they know that they will have to calculate medicines in micrograms or milligrams per kilogram to treat the baby. Having done the things that are necessary for the health and safety of the baby, the medical staff then dumb down the baby's mass into pounds and ounces so that the new mother can compare the 'weight' of her baby with the remembered 'weights' of the babies of her mother, her grandmother, her aunts, and her sisters. Sadly, by doing this, these collective mothers are putting the lives of babies at risk of treatment errors if the baby becomes ill.

Argument: Computers have their screens in inches.

Response: For years the television industry has lied about the size of the screen available to viewers using arguments about the internal size of the cathode ray tube (CRT) versus the size of the viewing screen that we actually see. For example, a (so-called) 21 inch screen has a viewable screen of about 19¼ inches. As early computers used television screens, this fraudulent practice came to the computer industry along with the screens. If you are about to buy a computer screen, and you are told the screen size in inches, it is best to assume that this is a lie and measure the screen yourself, preferably in millimetres.

Argument: Computer printers all work in inches.

Response: Computer printers are completely designed and built in SI units: they run on volts; their current is in amperes; the resistors are in ohms; their width, length, and height are in millimetres; and then they translate one of the metric measures to dpi to confuse the lucky punter. In your case the subterfuge worked.

Argument: More than 25 years after Americans were told their country would adopt the international measuring standard, the USA remain one of three nations – the others are Liberia and Myanmar – that doesn't use the decimal-based metric system of weights and measures.

Response: Liberia and Myanmar conduct trade with the nations around them on a daily basis. These neighboring nations are all metric countries. Liberia and Myanmar are going metric from the grass roots level and metric usage has advanced

greatly. It is no longer true to say that Liberia and Myanmar are not metric. The USA will now be the last nation in the world to openly accept metrication. People from the USA often use a statement like this to give support to the idea that the USA is not alone in their measuring practices. Usually they include two – curiously almost always two – of the following: Burma, Liberia, Libya, Myanmar, and Yemen.

Argument: It's been 25 years since America was supposed to begin converting to the metric system – and more than a century since President Andrew Johnson encouraged us to adopt it – and we're not much closer now than we were then. It must be too hard for Americans to learn.

Response: Every other nation in the world has successfully accepted the modern metric system. Sometimes it has taken them a long time to change, like the UK, and sometimes they have been able to change quickly, like Australia. It is hard to believe that the metric system is too hard for Americans to learn, since every person in every other nation has already done so.

Argument: Football is still in feet.

Response: It is amusing to watch football in the USA where the measure of ten yards is a crucial part of the game. From time to time two measurers run on to the ground with two upright sticks tied together by a piece of cord. They believe and most of the football fans believe that the piece of cord is ten yards long, but I know that the yard in the USA is defined in terms of the metre, so the cord is exactly 9.144 metres long – exactly – not a millimetre more and not a millimetre less — and not a yard anywhwere!

Argument: The computer industry used to use 3 1/2 inch disks and these were the world standard size.

Response: This is simply not true. The floppy disk was designed with a 90 mm wide by 94 mm long case that is 4 mm thick. The 90 mm was dumbed down to 3½ inches for use in the USA, and then that dumbing down was exported from the USA to the rest of the world. The new world standard is the 120 mm CD or DVD although few people have tried to dumb these down to 4 3/4 inches.

Argument: French and German plumbers use inches.

Response: What you say is partly true. A small number of French and German plumbers sometimes still use old word, inch, to refer to pipes, but, leaving aside the thought that the English inch, French inch, and the German inch are all different sizes, these old inch do not have, and probably never had, any relationship to reality. Old French plumbers sometimes refer to a 13 mm pipe as a 'demi pouce', which means half of an old French inch. Other French plumbers refer to this pipe size as a 'treize', which means a 'thirteen' (millimetres). The inches used by the plumbers are called 'nominal inches' and these can vary in size from place to place (e.g. the old *Pouce de Paris* was roughly 6% longer than the old UK Imperial inch). All pipes are now designed, made, and sold in metric sizes; the French plumbers might use the word 'pouce' but there has been no 'pouce' sized pipes in France for almost two hundred years. Neither the French nor the German plumbers are using real (international standard) inches. I suggest you actually measure some of their pipes; you will soon find yourself in the world of 'virtual' inch sizes where reality is regularly suspended – for the sake of a good story. One oddity in this story is that

many of the old pipe threads still in use in France refer to old English Imperial inches (and not *Pouce de Paris*) because most plumbing fittings installed in France at the start of the Industrial Revolution came from England, and French plumbers often have to seek fittings that are compatible with those old English fittings – it must be a nightmare for the French plumbers when their pouce is not a pouce because it's an old English inch, which is only a nominal inch anyway.

Argument: People's heights are still in feet.

Response: Heights are guessed more often than they are measured, so we need to have a measurement method that suits our inclination to guess a person's height so that we can describe them to others. It takes a while for people to develop their metric height guessing skills. To do this you need to guess in metres. If you walk into a room where there are several men look at their heights with the idea of picking the person whose height is in the middle of the range. This is the man of average height, and if the group is of a normal range of heights – you're not at a basketball party – then the person you chose would be close to 1.75 metres tall. Guess heights that end in zeroes or fives. Don't try to get any more precise than this; you can't guess heights like 1.73 m or 1.74 m so don't try. Now look at the women, Pick a woman of average height and she will be close to 1.65 metres. You can guess the heights of all the others by comparing them with your two average people.

Argument: I was in Germany last year and I could buy apples in Pfund. Even the Germans haven't changed fully to metric.

Response: When Germany changed to metric measures (in 1872) they changed the measurement but not the name of their unit for mass. The Pfund was changed from all of its old measurements to 500 grams exactly; so modern Germans use an old name for a modern measure. Curiously, at a different level, it seems clear, from experience around the world that metrication takes very little time; but for word patterns to change, it takes much longer. For example, we are still singing about a 'bushel and a peck' some hundreds of years after most of us stopped using either of these measures.

Argument: European countries haven't totally abandoned old measurements; they still use hours and minutes with hours that are 60 minutes in length, not 100 minutes.

Response: The idea of 60 minutes in an hour originated 3000 years ago in the city of Babylon, which is a part of modern Iran. This statement says nothing at all about the nature of the metric system.

Argument: In the UK, we have been free to use the metric system for over a century - there are still very few takers. Most people haven't changed to metric yet.

Response: This argument simply refers to the fact that anti-metric folk are a noisy lot and pro-metric folk are quieter. All UK manufacturing is done with metric measures where hundreds of thousands of metric measures are made every day, but at the end of the day, drinkers can still buy a pint of beer in a pub. Being able to use one old unit, out of the thousands they have used during the day, gives some people the illusion that nothing has changed. People who hold this view are wrong.

Argument: My customers don't understand the old measurements and that is good for me; I can tell them what I like, and they'll believe me.

Response: Sadly, I suspect that this has been the motivating force for the introduction and continuing use of many old measuring units. Unfortunately, many traders know this and they use it shamelessly. For a trader the perfect trading practice is to buy using simple, supported, SI units, and then to sell using whatever units that the trader makes up by themselves, or with the assistance of other traders in the same industry. Examples are buying diamonds by the gram and then selling them by the carat, or buying oil by the kilogram and then reporting its price, to the uninformed public, by the barrel.

Argument: My staff is too old and they won't go along with the change to metric. My staff is too young; they will not be able to handle the change to metric. Old weights and measures are preferred. Most people, in all age groups, prefer the old weights and measures.

Response: I simply don't believe you – show us your facts. Most very old and very young people in the world are quite comfortable using SI. Remember that 96 % of the world's people, of all ages, use SI as their measurement language. The experience of nations all around the world who have been through the metrication process is that age has nothing to do with metrication. More important is openness to new ideas and an attitude that embraces new things. If you believe that your staff is too old, think about my mother-in-law – at 97 she had no trouble buying 250 grams of cheese, or knowing that 40 °C was a very hot day – you must have really old staff. If your staff is too young, do your self, and your staff, a favor and buy a training program. SI is so simple that this is an easy solution, and you will find that it is quick, and it can be inexpensive.

Argument: Nobody wants SI.

Response: Overall this statement is not true. Currently, about 96 % of the world's people now prefer to use the metric system as their primary measuring method. So many people realise the advantages of SI that they are readily adopting it wherever they can. However, several people have tried to use the change to metric measures to promote other political campaigns. For example, the United Kingdom Independence Party (UKIP) used the so-called metric martyrs to gain publicity for their anti-Europe campaign. Overall, the noise and publicity given to anti-metric people is out of proportion to their numbers. Over time everyone who has used the metric system accepts it as the best available and then gets on with their lives.

Argument: Old measures are the 'industry standard'.

Response: This is not true. The standard for all measures, everywhere in the world, is SI, the modern metric system. Even in the nations where they use (say) inches and pounds, these are all based on metric 'standards'. In the USA, for example, an inch is defined as 25.4 millimetres and a yard is defined as 9.144 metres.

Argument: We do things that are familiar to our customers, readers, bosses, clients, etc. They do not understand the metric system and complain every time we use metric units.

Response: Some people always complain when they confronted with change – any change at all. Often when this happens they thrash about looking for reasons why they don't want change. They are not necessarily opposed to metric measures because they know little about them; the simple fact is that they don't like to change their minds. As an example, I once had a friend who vigorously claimed that he didn't like modern music. Every time anything that sounded vaguely modern came on the radio and TV, he immediately turned it off. How could he know whether or not he liked modern music –he had never heard any! I suspect that many people react the same way to metric units – they turn off their minds using the theory that if they ignore it, it will go away. If you are a team leader or a group manager, expect the moans and groans. Remember that it is one of your fundamental roles, as a manager, to manage change. You could look at metrication as a chance to hone your management skills.

Argument: Our national identity (in the USA) is defined by our difference to others, that's why we cling on to the old measures.

Response: SI simplifies communication between nations because every nation in the world uses SI units. This means that nations can seek real differences between them rather than using the artificial prop of measurement, which in the end has little significance as a point of difference between nations. In any case, it is a poor sense of national identity that can be threatened by the adoption of an international system of measurement. Metres and grams will not dim the colors of 'Old Glory', and they will not diminish the grandeur of Times Square.

Argument: People like the old ways better.

Response: Ignorance is always a strong motivator to retain old ways. People who know both old measures and the metric system – and therefore have the ability and knowledge to make a rational choice – always favor the metric system. It's a reasonable guess that anyone who uses the argument, 'People like the old ways better', is ignorant of even basic metric measures. It's a puzzle why people would want to use grains, drams, ounces, pounds, stones, hundredweights, tons, troy ounces, troy pounds, long tons, short tons, long hundredweights, short hundredweights, and many hundreds of others, instead of simply replacing all of these with grams, and kilograms.

Argument: People won't change to metric voluntarily.

Response: People constantly change to metric voluntarily. Almost the entire world population – 96 % or 6700 million people out of 7000 million – choose to use metric measures every day of their lives.

Argument: Politicians actively support and include references in speeches to the old measurements.

Response: Any group of politicians includes some who are conservative and some who are progressive. Perhaps you have chosen to quote the conservative politicians.

Argument: The majority of consumers do not understand metric measurement. Moreover, consumers are not demanding that their food products be packaged and labelled using the metric system.

Response: It might be fairer to say that the majority of consumers do not use or understand any measurement methods at all. They buy packages that are 'Yay big' or 'So big' (with lots of hand gestures) without reference to measurement information at all. This observation fits well with the experience of metrication in England where people were quite comfortable with metric packaging and protests didn't arise (and then from only a very small minority) until consumers actually had to say measurements like, 'Could I have a kilogram of bananas, please?'

Argument: The measurement issue will never be decided in a government office. It will be settled at the checkout counter, in grocery stores and kitchens, on the desks of editors and drafters, on shop floors, and on highways.

Response: This is true. The measurement issue has already been decided 'at the checkout counter, in grocery stores and kitchens, on the desks of editors and drafters, on shop floors, and on highways', and this has already happened all around the world. The decision was made in all of these places that metric measures were simpler and easier to use, so the metric system has become the dominant measuring system for 96 % of the world's population – so far.

Argument: The metric system is becoming more unpopular in Britain.

Response: Some politicians and some news media have successfully used the metric system as a symbol of the European Union's (Brussels Bullies) efforts to standardise British Weights and Measures (trample British culture and sovereignty under a foreign yoke). These people have quite deliberately used the metric system debate to support their rampant nationalism. The fact that the official name for the modern metric system is Système International d'Unités (International System of Units) doesn't help when marketing to those citizens of England, who are proudly, and loudly, anti-French. It's sad that this nationalistic attitude is depriving the English people of the benefits of using the metric system.

Argument: The metric system is breaking USA ties with British culture, and moving us toward European culture.

Response: These ties were accidentally broken, in 1834, when Parliament House in London burnt down, destroying the English measuring standards for the pound and the yard. From then, the UK and the USA chose to use different measurement methods. After the introduction of SI into the UK and the eventual acceptance of SI in the USA, it will be the first time, since 1834, that the UK and the USA, once again, have a common measuring language.

Argument: From what I see on television and read in the papers, the metric system is becoming more unpopular in Britain.

Response: The media will support anything that promotes controversy. They will promote any cause if they believe they can get people to feel strongly about. The issue doesn't matter – emotional content is all-important. The media in England, like the media in the rest of the world, loves conflict, so they have chosen to give loads of publicity to a small group of traders who are refusing to obey the measurement laws. There is, in England, a small group who will oppose metrication till they die; then they will be buried in a 1.8 metre grave. Remember, too, that many of the old measures were especially designed to confuse people when they were shopping. That's one of the reasons why we have two different ounces of

weight (Troy and avoirdupois), two different ounces of mass (Troy and avoirdupois), various fluid ounces, and all of the other ozs that come in UK and USA flavours. It is interesting to note that English traders protested just as loudly when they were forced to use the foreign Troy measures when they wanted to trade at the great fairs in Northern France, particularly at Troyes in Champagne.

Argument: I have asked several media outlets, print, radio, and TV, why they haven't changed to metric. They said that they couldn't change until the public had substantially changed to metric.

Response: This is just a circular argument that many journalists use to avoid a discussion about their numeracy. Although there are many exceptions, journalists are generally employed because of their literacy skills, and not because of their numeracy skills or mathematical knowledge. Many journalists are not only functionally innumerate, many actually fear having anything to do with numbers. News items from one SI nations can be readily understood in all other SI nations. This is not necessarily true for news items originating from the USA or going to the USA. News has to be translated for the USA – some say 'dumbed down' – and this is always accompanied by conversion and rounding problems with the possibility of significant errors.

Argument: Metrication is just putting new labels on existing measurements. Thirty-five millimetre film, for example, looks like it was invented as 1-3/8 inch, and then relabelled by manufacturers to make it a global standard.

Response: Worldwide, the photographic industry has had totally metric products since the Kodak company, in the USA, made a decision to produce B&W 16 mm film for amateurs in 1910 and their 16 mm color movie film, for professionals, in 1929; other film makers followed Kodak's lead. The photographic industry was one of the first industries in the USA to change to metric. The similarity of size between 35 mm and 1-3/8 inch is just a coincidence.

Argument: I have asked several companies, from the USA, why they don't use metric measurements on their web sites. They always reply, 'The web site is intended for our local audience in the USA'. When I ask why non-SI units are used on the same company's Australian or Canadian web sites, I get the reply 'We include it as a courtesy to our international (i.e. from the USA) visitors'.

Response: Do you get the sense of going around in circles? This is just a circular argument that is used quite commonly in metric discussions to hide the real argument. 'I don't want to change my mind'.

Argument: The metric system is for scientists and engineers, and not for us ordinary people.

Response: The metric system was originally designed to help prevent traders from taking advantage of ordinary people in the marketplace. In fact, the motto of the metric system has always been: 'For all people; for all time'. The world's scientific community uses SI units, not because they want to be different to everyone else, but because they know that it is easy to exchange scientific information and technology between different disciplines as well as globally if they use the International System of Units (SI). This means that scientific and technical journals never have any need to do conversions from old units into SI. It also means that every school child in the

world, who learns about SI at school, can understand scientific and technological reports and textbooks.

Argument: The press support the old measures: miles, ounces, gallons, and tons.

Response: When you use old units you have to be cautious because old measures can have many different values. A mile can be 'nautical', 'statute', or 'survey', and these have different lengths. Ounces in the USA are not the same as the English ounces; and dry ounces are not the same as fluid ounces or troy ounces. And as for gallons and tons, there are at least two quite different definitions of a gallon (UK and USA) and there are 14 different definitions of tons that are used, in the USA, to measure mass, force, power, volume, or one or other of three different kinds of energy; with the metric system, the rest of the world uses only a single litre and a single tonne.

Argument: The printing trade still uses old measures such as: ems, ens, points, lines, and inches.

Response: Are those inches international inches, French inches, or computer type inches? Ems and ens are sixths and twelfths of one or other of those inches. Remember that the size of a computer point is not the same as the size of a printer's point, so take extreme care if you have to use points. If you are not using SI in the printing trade, you have little in the way of standards to support you in international trade. Sanity will prevail as printers realise the ease of laying out printing work using millimetres for paper sizes and micrometres for print sizes.

Argument: The USA, which has one of the world's largest economies, uses English feet and inches, pounds and ounces, and intends to continue doing so. Why shouldn't England continue to use them too?

Response: It is not true that the USA uses English measures, even though many people continue to use the old names; English unit names were defined as metric units in 1959. This means that both the UK and the USA now use metric pounds, metric feet, metric inches, metric miles, and so on. Previously the UK and USA measuring units had different values and this caused considerable difficulty in trade between England and the USA. This is one of the main reasons that English speaking nations decided to change to metric definitions in 1959. For the first time ever, both nations now use the same all-metric definitions for almost all of their old measuring words (gallons are an exception with the UK metric gallon being different to the USA metric gallon).

Argument: We can still trade internationally with old weights and measures.

Response: International trade and commerce are much simpler with SI mainly because SI units mean exactly the same thing in every nation in the world. Imports and exports don't have to be repriced, repackaged, or overprinted for sale in other SI nations. Most new technologies incorporate SI so they can be readily traded in all nations of the world. Except for goods from the USA, it is unnecessary to live with the irritations of the endless conversion associated with old units of measure. Only goods from the USA have to have their packaging repriced, repackaged, or overprinted. In all of the world's nations (except the USA) all old packaging designations are virtually meaningless.

Argument: I know that the NY Stock Exchange and NASDAQ have used fractions of dollars until very recently. They avoided decimal money.

Response: The USA changed to decimal currency in 1793, one year after the opening of the New York Stock Exchange (NYSE). Because the NYSE opened before the introduction of decimal money, they decided to trade in Spanish Pesos that could be divided into eight parts, known as 'pieces-of-eight'. After 1793, the NYSE traded in dollars but continued to divide them into eighths in the tradition of the old 'pieces-of-eight' The NYSE continued this practice for 208 years, until 2001.

Argument: We can't work in metric because we talk inches and pounds all the time in our normal life.

Response: This is a curiosity brought about by the forces that operate during the process of metrication. The technical aspects are quite simple, and if done properly change fairly easily and rapidly. However, the social factors involved in a metric transition can be much more difficult to overcome. It is not unusual to find engineers, who work in metric units all day, discussing the heights of themselves, their children, and their favorite football players, in feet and inches. This simply reflects the advantages that are gained by doing engineering calculations in metric units as opposed to guessing someone's height; for one there are considerable financial and efficiency advantages, and for the other there are few benefits. However, it is a mistake to claim that because there are areas where the benefits of metrication are less than in others that we should not make the metric transition in any of them. In some areas, there are simply no old measuring units; for example, the understanding of electricity would simply not be possible using old units — there aren't any – all electrical units are metric units.

Argument: We just have to work in metric - the head office ordered it, but there are plenty of people in my office who would go back and work with the old inches and feet; they reckon it's more natural.

Response: This sounds like an argument where the metrication process was poorly done. Insufficient time was allowed for mindsets to change or the education component was unsatisfactory. In any case, get with it; get over it; and then get on with it. When the management of your company is looking for SI literate supervisors – don't be found chatting at the water cooler hankering after the old days – they've gone forever.

It’s too hard to change (17 arguments)

Argument: All of our old recipe books would become redundant.

Response: Textbooks, teaching aids, and all other educational equipment written in SI units are useful in all nations of the world, whereas, textbooks, teaching aids, and other educational equipment from the USA are useless anywhere else in the world because they are written using old units. When the USA changes to metric measures they will be able to export their textbooks, teaching aids, and other educational equipment to other countries.

Argument: All our recipe books, formula books, and production guides are written in the old measures. It would be too expensive to change them.

Response: Have you considered the cost of the calculation time and the cost of errors using the old methods compared to the simplicity of SI? Have you considered that metrication might be an excellent opportunity for you to revise your 'recipe books, formula books, and production guides'? It may be that a review and a revision of your measuring procedures is long overdue.

Argument: Halves, quarters, and eighths are better than decimal because all you have to do is halve things.

Response: There was an old medieval English ‘doubling’ system for measuring volumes. It never worked in practice, but remnants of it are still with us. It started with the idea that 2 mouthfuls were equal to a jigger or a mouthful was half a jigger. Next, two jiggers made a jack, or a jigger was half a jack. The whole series went like this: mouthful, jigger, jack, gill, cup, pint, quart, pottle, gallon, peck, pail, bushel, strike, barrel, hogshead, butt, and finally tun. Unfortunately traders corrupted it from the start by making odd sized containers, rather than doubling each measure, so the measures never worked as a system. It is possible that the nursery rhyme ‘Jack and Jill (Gill) went up the hill’ was a reference to the use of these units for collecting excise taxes on alcoholic wines and spirits. If the founders of SI had decided on doubling numbers, we could have bought our two litre milk containers by the 'pottle'.

Argument: It is too expensive to change to metric.

Response: It is too expensive not to change to metric. During metrication in Australia many companies estimated that converting to SI would involve them in considerable expense; after metrication they were surprised to find they had actually saved money. This was largely due to the reduction of the number of sizes of wire, nuts and bolts, etc. that they had to stock; and these savings continue forever.

Argument: It will take too long a time before we become conversant in metric. We don't have this time because we have our work to do.

Response: All you have to do is to decide that you – that's you personally – will change to SI. That decision might take you about 3 milliseconds and after that, everything is easy. What you are really saying is that it might take you a long time to prepare yourself to make this decision and it might take you a long time to convince your associates that you have made the right decision.

Argument: It will take too long a time before we become conversant in metric.

Response: It takes about an hour to begin to develop your metric mindset if you spend one single hour measuring the things you use every day. A good place to start is to measure your hands and feet. Here are my measurements to give you a starting guide. My thumbnail is 1 mm thick; my little fingernail is 10 mm wide; my fist across the knuckles is 100 mm wide. My hand span is 250 mm and the length of my cubit (elbow to tip of long finger) is 500 mm. My foot (in socks) is 320 mm long and 125 mm wide, and this means that my metric shoe size (called Mondopoint) is 320/125.

Argument: Metric units aren't easy for the average person to guesstimate.

Response: All guesstimates are based on experience. The more experience you have the better your guesses. This is true for all measures, whether old-style or SI. As good guesstimates come from experience, you need to develop your metric experience to be a good metric guesstimator. To begin this development draw a square metre on the floor and leave it there for a few days (or even weeks) until you get used to the idea of its size. Mark out a length of 10 metres where you can step it out and practice pacing with a one metre pace, or a half metre pace if it's more comfortable (When I did this, I marked the ten metres on a path between the car park and my office and practised every day.) Keep practising until you are confident of your ability to estimate in metres and square metres. For smaller measures, look at my measurements in the previous response – measure yourself the same way.

Argument: We think that changing to metric would be too difficult.

Response: Then you would be the first in the world to find this to be true. Not only have people who have metricated found it easy, but also they have always refused to return to the old ways once they have changed. This is true for individuals, for groups, for companies, and for nations.

Argument: We think that changing would be too expensive. Our entire inventory is in old units and the transition to totally new stock would take a very long time and would be too expensive.

Response: During metrication in Australia, many companies were hesitant and – before the event – they projected that metrication would be very costly. One company detailed its metrication costs at $550 000. However, after the event of metrication many of these companies realised that metrication had not been a cost but a benefit to them. In the case of the company that estimated its costs at $550 000, it recouped these costs in less than three years and the savings it achieved, in 1973, through metrication, are a continuing benefit today. The savings were largely due to the reduction of the number of sizes of spare parts such as wire, nuts and bolts that they had to stock. These companies now view metrication as a rare opportunity for modem industry to totally revise products and adopt newer and more effective procedures. Australian examples of this type of process improvement included the standardisation of the location of screw holes on hinges that reduced the number of standard hinge sizes from 153 to 11 to suit the same applications as before. Another Australian example was the reduction of the number of steel sections, to rationalise the sizes of oil drums, from 55 to 11. You could use the opportunity provided by metrication to rethink your inventory position. If you are holding stock in inventory for too long it's probably about time you had a review anyway.

Argument: All our tools are in old units. We would have to buy a new set of metric tools.

Response: You are going to buy a new set of tools anyway, to replace them as they wear. Make sure you aren't stuck with the expense of two sets of tools. Make the decision to change to SI as quickly and as cleanly as you can. Experience in all countries has proved that repairs and maintenance of equipment, such as cars, videos, and cameras, is simpler with SI. This is because it is easier to design and fit parts in metric units. There is a cost of retooling during the metrication process, but

good companies have used metrication as an opportunity to retool and to align themselves with the best world practices.

Argument: Aircraft heights are in feet.

Response: The height of an aircraft is based on air pressure measured in pascals, an SI unit. This is then converted into height in metres by computer. Some pilots then change this so they can report to the passengers in feet. Personally, I would prefer the pilot to be concentrating on flying the aircraft, rather than doing these completely pointless calculations.

Argument: Some things should not change for safety reasons. For example, aircraft should continue to fly in nautical miles and feet. The aviation industry seems quite happy using feet and nautical miles.

Response: From a practical point of view aeroplane manufacturers know that – sooner or later – they are going to use metric units – so they have already done so – and then hidden them. Planes built in the last 10 years or so have electronic flight instrument displays that are built to operate according to ICAO (metric) rules. This practice also fits in with the fact that more and more planes are relying on the satellite based Global Positioning System (GPS) to find out where they are. The GPS, too, was designed and operates in metric units. However, with the push of a button, all of the displays in the cockpit can have conversion factors applied, and have the electronic displays revert to old units. The altitude that was determined in metres and given in metres now appears in feet. The speed that was calculated in kilometres per hour and given in km/h now appears in knots. The height that was determined in metres and given in metres now appears as feet. And payloads and fuel loads that were determined in kilograms now appear in pounds. All the original metric measures are hidden by electronic displays. I sometimes wonder what would happen if someone bumped the button that changes all the readings from the ICAO settings to the old USA values.

> *Pilot: 'Hey what are these mountain goats doing way up here in the clouds?'*
>
> *Co-pilot: 'In flight school I learned that these kinds of clouds are called 'cumulo-granite.'*

Loud crashing sounds then silence!

Argument: The brain easily accommodates repeated halving (and doubling), which is another way of saying 'powers of two', but powers of ten are anything but natural.

Response: Of all the possible numbering systems most have been tried by humans, somewhere and at some time. For example, the Babylonians tried sixties, the Romans tried twelves, and twenties were used in English money. After all these experiments, all of these nations (Iran, Italy and the UK) have now decided that tens are the most practical for money and for all measurement. Powers of two were tried in the doubling and halving measures in mediaeval times but, clearly, they did not have proven staying power.

Argument: What will happen in our schools, when our kids have to learn both the old ways and the new system?

Response: SI is demonstrably easier to learn and to remember. Estimates made by sociologists, in the USA, estimate that the use of SI can shorten measurement education in a twelve year life at school by, at least, one full school year. All over the world, SI has been the basis for very significant improvements in the techniques of teaching physics, engineering, and all of the other sciences. However, school students should never have to 'learn both the old ways and the new system'. School administrators should simply make a decision to change to the metric system immediately and have nothing more to do with old measures.

Argument: American children have the advantage of learning two methods of measurement – US customary measures as well as the metric system.

Response: What you say is incorrect. A key disadvantage to the children of the USA is having to learn two methods of measurement. Children in all other parts of the world study only the units of the International System of units. All of the teachers, language, science, and social studies, use only SI units every day. The children and their teachers use these units in their daily lives as well as in their school studies.

Argument: We should use dual measurements. This gives us the greatest variety and choice. **Response:** Variety and choice in measurement lead to inefficiency and increased cost. Some people argue that it would be better not to change, at all, until you are ready to change to metric completely. SI is very much the best choice, the old ways are second best, and dual measurements are a long, long last.

It is old - therefore it is good (10 arguments)

Argument: Inches, pounds, and yards are part of our heritage and as such, they should be retained forever. **Response:** As words, they probably will be retained forever. We will still 'inch forward', love someone 'a bushel and a peck', seek a 'pound of flesh', and 'do the hard yards', but these old units will never be supported, as measuring units, by international agreements for international trade. Already, 96 % of the world's people use SI daily and even in the USA, the last nation on Earth to avoid the metric system, inches, pounds, and yards are defined using metric measures.

Argument: Calculating in the old units works well.

Response: Which of these would you rather do?

- Add 1 yd 2 ft 3 1/2 in to 3 yds. 1 ft 8 3/4 inches
    - or add 1.613 metres to 3.270 metres;

- Subtract 2 yds. 1 ft 8 3/4 inches from 3 yds 2 ft 3 1/2 in
    - or subtract 2.270 metres from 3.613 metres;

- Multiply 1 yd 2 ft 3 1/2 in by 3 yds. 1 ft 8 3/4 inches
    - or multiply 1.613 metres by 3.270 metres;

- Divide 3 yds. 1 ft 8 3/4 inches by 1 yd 2 ft 3 1/2 in
    - or divide 3.270 metres by 1.613 metres.

Any body who ever actually goes to the trouble of calculating these eight problems, will never willingly choose the old methods for calculations ever again. And they can use their calculators for the metric calculations, but they have to use pen and paper for the old ones.

Argument: Metric is a sterile evolutionary dead-end. The leading-edge work in fundamental physics has abandoned metric and is using so-called 'natural units'.

Response: Scientists love jargon, so they regularly create words and even languages that will give the impression that they are different (and therefore special) people. A part of this special language building is to create words and then use them as jargon to exclude others from their exclusive group. My favorite is the word 'barn' that is used by the cognoscenti, in place of a square femtometre. I suspect that some nuclear physicists were ribbing each other about the size of a nuclear target they could hit. When one of them said, 'You couldn't hit the side of a barn', this simply became the jargon for square femtometre. With only a little knowledge of SI prefixes we can all get some understanding of a square femtometre, but you have to become part of the 'in group' of nuclear physicists before you will understand the full meaning of a 'barn'. There is a place for seeking such things as 'natural units' but don't ever forget that the drive among scientists to create jargon is also incredibly strong – don't get confused between these two competing forces.

Argument: Old measures require greater numeracy than metric, but this is a skill to be encouraged! It is part of our culture and history and should not be replaced by a soulless alternative.

Response: It is not true that 'Old measures require greater numeracy than metric'. This perception arises because old measures require greater memory skills – you have to try to remember all the names of the old units, all of the old conversion factors between them, and which ones are appropriate in the present circumstances. The level of numeracy is probably about the same, with an advantage for the decimal metric measures because it consistently uses decimal fractions.

Argument: Old measures arose when they were needed in history and they are the best measures because they were chosen from experience.

Response: Because old measures arose randomly throughout history, they have never had any coordination into any sort of system – even though some attempts were made to make old measures systematic – it never worked. On the other hand, the metric system was designed so that metric units are all logically related to each other. This was refined even further when the metric system was formed into the International System of Units (SI), in 1960.

Argument: The old units are part of our heritage. Our weights and measures have been used for centuries in our literature, from Shakespeare to Roald Dahl. Their loss would further weaken understanding and appreciation of this inheritance.

Response: In literature, measures are used more for their connotations as words, rather than as rigidly precise units of measure. In 'Measure for measure', Shakespeare was talking more about getting even rather than thinking of precise measures; and he used the expression 'a pound of flesh' figuratively rather than

precisely in 'The Merchant of Venice'. We will always use these old unit words in the ways that the writers intended.

Argument: The proliferation of apparently unrelated units of measurement in our system is anathema to the tidy minded. However, if it is so bad, why has it survived all these centuries?

Response: It hasn't survived in any way as a 'system' – it has been constantly changing and altering to suit the political and commercial realities of the times. There have been regular wars and revolutions over unjust and unfair measures. Until the metric system was developed, there had never been a universal system of units that everyone in the world could rely on.

Argument: This 'Think Metric' program failed miserably, because it stressed simply conversion, with no practical application. Feet and inches, gallons and pints, pounds and ounces are better. They are more practical than metric units for easy division into useful fractions.

Response: What you are saying is based on your mindset. Because you have more experience with the hodgepodge of old units, and less with the modern metric units, you are making an unfair comparison and basing your decisions about measurement based on your unequal knowledge and experience.

Argument: Metrication has had the same effect of mandating a language change from English to Esperanto.

Response: Four methods of written communication are recognised everywhere in the world. These four successful methods can be understood wherever you are in the world and whatever language you speak and write. It doesn't even matter if you write with an alphabet or use pictograms; you will still be able to understand these four international methods. The four methods that cross all language barriers are: the way of writing notes for music; the set of mathematical signs and symbols; the symbols for chemical elements, and the International System of Units (SI). Esperanto is not one of these four so it should not be compared with them.

Argument: It's still 200 miles from San Antonio to Houston, not 321.8 kilometres; a hot summer day is 100 degrees Fahrenheit, not 37.777 degrees Celsius; and San Antonio Spurs basketball player, David Robinson, is seven feet tall, not 2.1336 metres.

Response: Is the distance between San Antonio and Houston exactly 200 miles, or would saying '320 kilometres or even 300 km' be accurate enough; is 37.777 degrees Celsius, another too exaggeratedly accurate conversions from 100 degrees Fahrenheit, or could you say 38 degrees Celsius or even 40 degrees Celsius; and does Mr. Robinson really measure exactly 7 feet? Maybe he is 6' 10 2/3" and that would make him 2.1 m tall. Competent users of metric measures use rounded values; just as users of old measures use rounded values with old units. You're not cheating again – are you?

Metric is foreign (9 arguments)

Argument: Metric is not 'American' or 'English'; it's foreign.

Response: The metric system is as 'American' or 'English' as it is 'European'; it is the global international language of measurement. Paradoxically, the United States was almost the first country to adopt the metric system when Thomas Jefferson (1743/1826) and John Quincy Adams (1767/1848) recommended conversion to the metric system for the USA to replace the existing Imperial system sometime before 1784. The USA now has the distinction of being the first nation to consider the metric system and the last nation in the world to openly accept it. It was the British Association for the Advancement of Science who reformed and improved the metric system in the second half of the 19th century. Examples of SI units named for scientists and technicians from the UK and the USA are: farad, gray, henry, joule, kelvin, newton, siemens, tesla, and watt (notice how these English and Scottish family names use lowercase letters when they are used as units).

Argument: Compulsory metrication is undemocratic. The introduction of metric is unauthorised by any democratic process. There has not been a referendum on metric measures.

Response: It is true that metrication has never been introduced anywhere in the world following a plebiscite; it is also true that no other method of measures have ever been introduced after a referendum – there was no referendum to introduce inches, feet, pounds, and gallons. Nations use either legislation or constitutional powers to provide for 'honest weights and measures'. This power is then delegated to groups of measurement experts who devise appropriate methods for each nation. In the case of the International System of Units (SI), the legislation is an international treaty known as the 'Treaty of the Metre', and this is supported by each nation's legislation. The USA was one of the first 17 nations to sign up to the 'Treaty of the metre', in 1875.

Argument: The edict making metric units compulsory for pre-packaged goods, and those sold by length, was rubber-stamped by Parliament without proper consultation or debate, against the public's wishes.

Response: You put a highly emotive argument. Measurement legislation and regulation have always been subject to debate, as they are far too important to everyone not to be fully and vigorously discussed. However following these discussions, appropriate legislation and regulations must be written and enforced. If measurement becomes the subject of random decisions by many individuals, there would be no trustworthy system in place, as there would be too many disputes. Applying this notion to all of government, there would be anarchy – no nation could be governed at all.

Argument: I posted a message on an email discussion site, advocating that weather be given in metric units. The answers given included: 'Move to Europe'. 'What are you, boy, one of them foreign national subversives?' 'This is the US of A, we don't need no stinkin' metrics'. 'We like using feet, gallons, and cubic inches, not this quiche-eating 'metric' stuff'. and 'People who believe in the metric system are commos'.

Response: These rather sad remarks make a telling point. People can feel very strongly about the measures they use. The minority view expressed by these people intuitively recognises that measuring units affect everything that we do, all the time,

wherever we are. Measurement is extremely important to us all, and we need to consider the strong emotional responses that they engender whenever we plan a metrication program.

Argument: Metric measurement is un-American and socialist.

Response: Thousands of young men and women get trained to use the metric system in military training in the USA and for overseas military operations. These military personnel often get posted overseas where they see ordinary people using metric measures every day. Are you saying that you think that the army, navy, and air force of the USA are un-American and socialist?

Argument: Metric is for third world countries.

Response: It is true that third world countries gained enormously when they metricated. It is also true that developed first world countries benefit even more than third world countries, mostly because they have more industries based on science and technology that benefit directly from the metrication change. However, the biggest winner from metrication will be the USA when that nation finally figures out how to make their metrication change.

Argument: Metric is not 'American' or 'English'; it's foreign.

Response: It is true that metric is not 'American' or 'English'; it is fully international and universal. Children in all nations (including the USA) are taught SI units in mathematics and science at school and university. People from SI countries have no trouble travelling in other SI countries. They don't have to have special measurement training to travel in any other SI nations. For most people in the world, they already have a working knowledge of SI, so they don't feel that they need to learn about old measurements. Only if people travel to the USA do they have to learn an old measurement language.

Argument: Metric is not American, we use good old-fashioned measures.

Response: People all around the world know that if you buy equipment from the USA, you also need special tools and special trade training for your staff. Manuals and instructions related to USA equipment require conversion by highly skilled tradesmen or staff at technical colleges or your employees have to be retrained to use them. Craft books from the USA have little application because they do not relate to measurements and materials anywhere else in the world. It is costing the USA an enormous amount of money to remain isolated – in measurement terms – from the rest of the world.

Argument: We don't export anything at our company so we don't have to change. The metric system is foreign – it's un-American. Metric is for foreigners.

Response: This idea of maintaining social and measurement isolation from the rest of the world means that the USA has less access to all of any good ideas that arise from the rest of the world. With SI, there is greater international standardisation and interchangeability of qualified and trained people, machines, equipment, and spare parts. Every company in the USA, that adopts SI, will benefit from the change and you are competing with them even if you don't export anything. After you change to SI, you will then be able to expand your markets

globally. SI stands for Système Internationale d'Unités – the International System of Units – so once you adopt SI, you become part of the global market.

There's nothing wrong with the old methods (8 arguments)

Argument: Learning fractions at school was good enough for me - so it's good enough for my kids - it'll do 'em good. Metric doesn't have any fractions. What will we do when we want a half, or a third, or a quarter?

Response: You'll still use a half, a third, or a quarter in appropriate circumstances. As examples, consider a half litre of paint; a quarter kilogram of bacon; or cutting a 2400 mm x 1200 mm sheet of plywood into quarters, thirds, or sixths, to make some shelving. Kids will still learn about fractions at school. You, and the kids, will continue to divide a pie into halves, thirds, or quarters, but, in future, you will not use fractions so often when you are measuring. I would have thought that any parent, who cares for their children, will want them to learn to measure as quickly, as easily, and as painlessly as possible, and for this fractions are not the way to go.

Argument: Old measures are part of our culture, history, and heritage, and as such, they should be retained forever.

Response: Bedpans and night soil carriers are part of our heritage too, but fortunately, we have realised that sewerage systems are better. 'Royal cubits' and 'a just ephah, and a just hin' are also part of our culture, history, and heritage. We will continue to use all of these to enrich our language, just as we will continue to do the 'hard yards' as we 'inch forward'. However, these words will be used less and less as measuring units as SI units replace them.

Argument: SI means that everything will be decimal – eights in a boat race will have to be extended to tens; and Beethoven will have to be resurrected to write another symphony.

Response: This is nonsense, of course, some things are best done in tens (all calculations); some are best done in twelves (dozens of eggs); and some are best done in sixteens (pages in books). In future we will still choose the best number for each job, but we will probably choose tens when we need to do any calculations to make the decimal arithmetic easier.

Argument: I don't see what all the fuss is about. It doesn't take a rocket scientist to understand the USA and English methods of measurement. 12 inches = 1 foot, 3 feet = 1 yard, 5280 feet = 1 mile.

Response: Rocket scientists don't have a good reputation when it comes to old measurements. Perhaps you haven't heard of the demise of NASA's Mars Climate Orbiter. The loss of the Mars Climate Orbiter, at a cost of 125 megadollars (M$), is an excellent example of what can happen when you use dual measurements.

Argument: SI means we won't get 12 oysters in a dozen any more – we'll only get 10.

Response: When SI was introduced into Australia, a few sharp restaurateurs tried to promote the idea that oysters now came in 'metric dozens' of ten oysters, rather than the traditional twelve. These traders were quickly recognised as the rogues

they were, and the practice is never likely become widespread. Hang out for your two extra oysters – if you ordered a dozen, you ordered twelve oysters.

Argument: The old ways are more intuitive than metric.

Response: This argument is really saying, 'I am familiar with old units, but I am not yet familiar with metric units'. For most people, it takes less than an hour to become competent in using metric measures. It only takes this short time because SI is truly intuitive in that the decimal numbers used by SI are the same as the decimal numbers we use every day for all of our calculations.

Argument: These old measurements remind me of thumbs and feet and paces. They relate to the familiar. I have a mental picture of what they are.

Response: Your thumb is about 25 mm wide; your feet are about 300 mm long; and your pace is about 750 mm. It is very easy to develop familiar mental pictures with metric units. You could also look at your little finger nail – it is about 10 millimetres wide; and look at your fist – it is about 100 millimetres across the knuckles.

Argument: We'll get ripped off in the shops because of metric downsizing.

Response: In ancient Rome the emperor, Diocletian, wrote a long edict in an attempt to prevent traders corrupting the Roman weights and measures – he failed. Traders continue to attempt to change measurements to suit themselves, and they don't mind if they do this in libras, unciae, and scruples; livre and troy ounces; pounds and inches; or metres and millilitres. Of these, the hardest to cheat is the modern metric system, because the SI units are very tightly controlled, in exactly the same way, in every nation in the world.

We should have freedom of choice in measurement (7 arguments)

Argument: International bureaucrats want to build a 'one size fits all' world where it is easier for them to regulate more and more aspects of our lives.

Response: It is true to say that there are bureaucrats who believe in improving communication between nations. These people recognise that SI is a major tool to help achieve this goal, as SI is the world's largest single language of measurement.

Argument: Old measurements are more flexible. There is a wider choice of units and a wider choice of conversion factors.

Response: This is a flexibility that has to be earned by extensive – and expensive – training, and this training that is not portable from one industry to another. For example, if you become a jewellery expert, who understands carats of gemstones and Troy ounces of precious metals, this does not help you cook your evening meal. There has never been any evidence that a large choice of measuring units makes measurement simpler, more open, or more honest. In fact, the available evidence contradicts this idea. There have been many units invented with the express goal of deceiving the public. In modern times the barrel for oil and the carat for diamonds are specifically not designed to make transactions clear to all concerned.

Argument: We should have freedom to measure any way we like. We should end compulsory metrication. Defend your freedom to use British weights and measures. Beware, that we do not lose an ancient freedom.

Response: Every government that has ever existed soon realises that units of measure are so important, and affect our lives in so many ways, that they cannot be left to the citizens to decide units of measure for themselves. Not since 1324, have British people had the freedom to use any measures they like. Since then, measures have been regulated continuously, not only in England, but also in every other nation in the world. It only takes one unscrupulous trader who uses a smaller pound than others to affect all traders who then have to cheat to compete. All governments, eventually, have made one set of measuring units compulsory, and all the nations of the world, including the USA, have chosen to use SI units as the basis of their measuring systems.

Argument: We should be free to choose our measurements; we should be given freedom of choice. A citizen should be able to choose what units they choose to use and governments should not be able to stop them. We need active public support to get the Government to end compulsion, and to give us the freedom to measure how we like.

Response: This is the classical position of any trader – but only when they are selling. When they buy, they want the government to legally support a proper measurement system.

Argument: Is it a crime to be British? From the end of 1999, it has been illegal to sell fruit, vegetables, etc., priced by the pound. It is a criminal offence to use our own pounds and feet for trade in our own country.

Response: I take it you are referring to the avoirdupois pound from France and the Roman foot from Italy. Governments have always preserved their right to define the weights and measures that can be used by their people so that they can reduce the number of measurement frauds and disputes.

Argument: We already have decimal currency. Why do we want everything else to be decimal? What's wrong with variety?

Response: SI is much easier to use because it has one, and only one, unit to measure each physical quantity. Every known physical quantity has its own unique unit in SI. For example, the metre is used to measure the physical quantity of length. For shorter or longer lengths the unit metre can be modified by prefixes; millimetre means one thousandth of a metre and kilometre means one thousand metres. Here is a complete set of metric units needed to measure lengths in everyday life, (say) to build a house or a multi-storey office building:

1000 millimetres = 1 metre 1000 metres = 1 kilometre

Compare this to the variety that is possible with old measures. A length could be measured with: air miles, angstrom units, astronomical units, cables, chains, computer picas, computer points, drill numbers, European shoe sizes, fathoms, fermis, furlongs, gauge numbers, geometrical paces, hands, inches, international feet, international miles, light minutes, light seconds, light years, links, microinches, mils, military paces, nautical miles, parsecs, poles, perches, printers' picas, printers' points, rods, screw numbers, shotgun gauges, UK shoe sizes, US shoe sizes, US survey feet, US survey miles, standard plate gauges, vinyl gauges, wire gauges, and yards.

Argument: We can handle metric; but that doesn't mean we want to ditch the old measures. We could use both measurement methods together at the same time with old measures for some things and SI for others. We do things in metric some of the time. We are flexible here; we can use both methods - the old as well as the new.

Response: Have you stopped to calculate the costs of a dual system? Your costing should include the time taken for all of the conversions, plus the extra printing costs for control charts etc., plus any costs of errors that you might sometimes make when you are doing this highly pointless task. The worst possible result of a metrication program would be to produce a company, or a nation, with two or more randomly applied measurement methods in operation. This is the most costly result as it means that you have multiple constant conversion calculations with their attendant errors and accidents. The loss of the Mars Climate Orbiter, at a cost of 125 M$ USD, is a good example of the use of dual measurement methods. *The miracle of the Gimli Glider* where pounds of fuel were supplied when kilograms were requested is another example (see http://en.wikipedia.org/wiki/Gimli_Glider).

Old measures are natural (6 arguments)

Argument: Britain has used both decimal currency and the metric system since 1964. That there is still strong resistance to metrication in England shows that the metric system is not natural. Even after all these years, it has not been accepted.

Response: There is also strong support for metric measures, the difference is that the support for metric tends to be silently going about the business of building new buildings, making new machinery, and creating new economies; the detractors of metric measures are much more vocal and spend a lot of their time protesting.

Argument: The old measures are natural. A woman wears size five shoes, size twelve dresses, size six gloves, and size thirty-two hats, and she knows all these sizes and she can remember them easily.

Response: It is true that we can remember some of these strange old numbers, but most of us have no idea what any of them mean. Traders can – and do – change the values of the sizes as often as they like. Have a look through your shoes, clothing, and hats – how many do you have that were bought for your size number but you haven't worn because they don't fit. Using the old size numbers, it is highly likely that you are being ripped off – regularly. With equivalent metric sizes, this woman's clothing could go like this. Her 'Mondopoint' shoe size (the length of her foot rounded up to the next 5 mm) is 240 mm. Dress sizes vary widely from maker to maker but a mid range 'Size 12' would give her a bust of 850 mm, a waist of 650 mm, and hips of 900 mm. Her glove size is 150 millimetres. If this woman's hat size is really 32, she either has an extremely large head or her hat keeps falling off – hat sizes range from very small hats of 500 mm to very large hats of 650 mm – medium size is 575 mm (an old hat size of 32 is equivalent to 815 mm).

Argument: The old system is natural: my thumb is an inch across; my hand is four inches wide; my foot is about a foot long; and when I pace each step is about a yard and it's about a yard from my nose to the tips of my fingers. The old measures were designed to a natural human scale.

Response: The metric system is natural. My thumb is 25 millimetres across. My hand is 100 millimetres wide. My foot is about 300 mm long and when I use a long pace each step is about a metre. It's about a metre from my left ear to the tips of my fingers on my outstretched right hand, and it is about a metre from the floor to the point of my hipbone. Obviously, the new metric measures were designed to a natural human scale. Actually, as you and I have both shown, we can choose any measures we like to prove that any measuring method is 'natural' and 'designed on a human scale'. In these examples, you chose simple examples that would support your argument. You cheated – and so did I.

Argument: The old system may be less rational, but it is more human. The inch was first defined in 1150 by King David I of Scotland as the width of a man's thumb at the base of the nail. Edward I of England redefined the inch in the 13th century to equal three grains of dry and round barley laid end to end. The inspiration for the foot's definition should be obvious. The mile comes from the Latin, 'mille passus', which means a thousand steps.

Response: This argument is a good demonstration to show that all of the old ways of measuring were completely uncoordinated; the sources of these measures stretches across many nations and across many thousands of years. There never was an old 'system', and there has never been any possibility of coordinating all these old measures. On the other hand, the metric system was closely coordinated ever since it was first developed. SI is a simple, coherent, system of units, it is an all embracing, conceptually accurate system of units in which the unique unit of every known physical quantity can be derived from only seven base units and the meaning and definition of each physical quantity is explicitly expressed in its unique SI unit symbol. Before the development of SI, there never had been any coordinated system of measuring units.

Argument: We have a feel for acres – hectares just don't make sense.

Response: I doubt that you have a feel for acres – quickly now – if an acre was laid out in the shape of a square how long are its sides? Congratulations, if you guessed that the sides would be about 69 yards 1 foot 8 and 71/128ths inches. After a few minutes of examining a hectare in the shape of a square, you would realise that each side was exactly 100 metres, and you could easily measure one side of a hectare using the odometer's decimal numbers on the trip meter of your car.

Argument: When you convert to metric you get strange numbers - for example, 4 inches comes out at 101.6 millimetres - and that's a lot harder number to say and to deal with than 4 inches.

Response: When you convert from metric you get strange numbers - for example, 100 millimetres comes out at 3 1919/2048ths inches - and that's a lot harder number to say and to deal with than 100 millimetres. Actually, you can choose examples to demonstrate the superiority of either old measures or the metric system. In these examples, you cheated – and so did I.

I don't want to change my mind (2 arguments)

Argument: We simply don't want to change. SI is unfamiliar to me and the old measures are familiar to me.

Response: This is a typical response from someone who is unaware of how much they use metric measures already. They are unaware that they use metric medicines, drive metric cars, eat metric food, and even use metric pounds and metric inches. People who make this statement are either profoundly ignorant of their surroundings or they are 'in denial'.

Argument: In the USA, we have always done it this way. We don't object to metric - we just don't want the USA to change.

Response: It is not true for people in the USA to say, 'We have always done it this way'. The USA has been changing to the metric system since about 1785. There are many in the USA who do not know about, or care to admit to, the widespread use of SI in the USA. Currently, it is estimated that more than 40 % of industry in the USA uses the metric system internally and more than 90 % use SI units for imports and exports. The change to SI is happening all around you, and if you want to stay in business, you will be forced to catch up to your competitors.

If this is all too negative for you, go to: http://www.MetricationMatters.com/why_metrication.html to find many positive reasons why we should complete the process of going metric — NOW!

Metric system consultant, writer, and speaker, Pat Naughtin, has helped thousands of people and hundreds of companies upgrade to the modern metric system smoothly, quickly, and so economically that they now save thousands each year when buying, processing, or selling for their businesses. Pat provides services and resources for many different trades, crafts, and professions for commercial, industrial and government metrication leaders in Asia, Europe, and in the USA. Pat's clients include the Australian Government, Google, NASA, NIST, and the metric associations of Canada, the UK, and the USA.

Pat specialises in the modern metric system based on the International System of Units (SI), but he is mostly concerned with the processes that people use for themselves, their groups, their businesses, their industries, and their nations as they go about their inevitable metrication process. See http://www.metricationmatters.com/ for more metrication information, contact Pat at pat.naughtin@metricationmatters.com or subscribe to the free 'Metrication matters' newsletter at http://www.metricationmatters.com/newsletter/