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FROST & SULLIVAN

MEGA TRENDS

By Manoj Menon

Asia Pacific Market Insights

Frost & Sullivan's commentary on the effect of Mega Trends across industries, addressing opportunities, best practices, and major events

"We accelerate growth"

The Importance of Mega Trends for Long-Term Sustained Growth

Every year, thousands of new companies are formed globally. A large majority, well in the excess of 90 percent, do not survive more than two or five years. Just a handful survives beyond 50 years. A large contributing factor is that existing customer needs that these companies were formed to address had became irrelevant over a period of time. Most companies also fail to be able to scale their business and cross US$100 million in revenues. For example, the Information and Consulting Industry that *Frost & Sullivan* participates in is an industry worth US$366 billion globally. Currently, there are just slightly over 100 companies with revenues over US$100 million and only 25 of them with a history of over 50 years. As *Frost & Sullivan* is celebrating our 50th anniversary this year, we thought it would be pertinent to examine this trend further in detail.

Frost & Sullivan has attributed trends that have profound impact on the business environment over a period of time, 'Mega Trends'. We define Mega Trends as global, sustained and macroeconomic forces of development that impact business, economy, society, cultures and personal lives, thereby defining our future world and its increasing pace of change. Mega Trends have diverse meanings and varying impact on different industries, companies and individuals. Analysis of these Mega Trends and their implications forms an important component of a company's future strategy, development and innovation process, and directly impacts product and technology planning.

To address this very important issue amongst our global customer base, *Frost & Sullivan* embarked on an ambitious global project to identify the top 50 Mega Trends. We assembled a global team of 150 analysts and consultants with expertise in various industries and economies. They brainstormed, built scenarios and generated ideas for future growth opportunities for businesses. Allow me to share with you some of our insights from delving into the repercussions of these trends and how they will change the pace and scenario of things as we know it.

Sincerely,

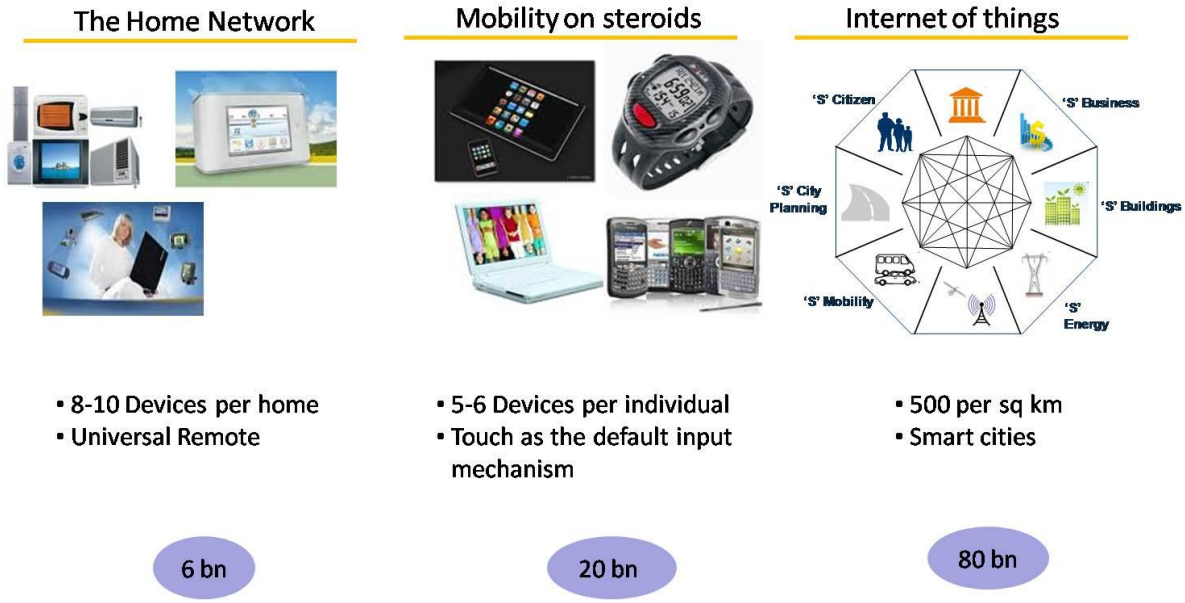
Manoj Menon

Manoj Menon
Partner & Asia Pacific Managing Director
Frost & Sullivan

Mega Trend 1: Moving from Connecting Subscribers to Connecting Devices

Prices of mobile devices as well as the tariffs for mobile services have declined sharply resulting in unprecedented growth in subscriber and penetration numbers. Mobile penetration in most markets today exceeds 100 percent. The economic value add that was created based on providing mobility to consumers has been significantly exploited. The Blue Ocean Strategy of creating new economic value is to shift the paradigm to connecting devices instead of connecting consumers. It is quite possible that if executed well, we will see penetration levels of 800 percent or a total connected device ecosystem exceeding 80 billion devices by the year 2020.

Whilst the connecting devices trend, i.e. Machine to Machine (M2M), is not new, the current ecosystem is ripe for an accelerated take up of this trend. Rapidly declining prices of radio and telecom infrastructure is a key enabler. Added to that is the fact that most countries today have ubiquitous broadband coverage – both fixed as well as wireless. The availability of platforms such as Android and iTunes amongst several others help leverage the collective innovation capability amongst millions of application developers globally. The baton for discovery of the applications has been passed on to the consumer and this wisdom of the crowds' phenomenon helps accelerate the development and innovation cycle.



The consumer electronics industry will be a key benefactor of this Mega Trend. Devices which operate in a networked environment will enable consumers to drive a greater degree of personalization. There will be an explosive level of innovation that will come through from the convergence of these two industries (consumer electronics and connectivity). In many instances the connectivity piece will be completely transparent to the end-user. We have seen the first signs of this emerging business model in the offering from Amazon Kindle with global connectivity and completely transparent carriage charges for users. Carriage costs are marginal compared to the overall benefit for Amazon as well as the consumer and hence the consumer does not get charged for the usage of data separately.

Implications for telecom service providers

This Mega Trend is a huge growth opportunity for the telecom service providers (telcos). Whilst the revenue streams will be possibly as low as a few cents per device per month, the number of devices that will be connected is huge. The telcos undoubtedly will earn revenues from the connectivity piece. This will, however, be commoditized and the margins will be under continuous pressure. The battle will be intense for the incremental revenues from the creation of the ecosystem. The first wave of the data connectivity phase has been won by Google, Apple, Facebook and other Over the Top (OTP) players. The upcoming wave of connecting consumer devices will attract the electronic giants such as Sony, Samsung, Panasonic, Philips and others. These companies approach the market from a very global perspective and their scale will be significantly higher than the telcos.

The competitive advantage for a telco resides in its strength in operational excellence, its monthly billing relationship with its customers and its strong local distribution presence. They need to adopt a two pronged approach to succeed. Firstly, they need to develop strong global partnerships with the likes of Sony, Apple, and Google and be an early entrant into the market to garner a significant share of the connectivity pie. Secondly, there are several areas which will favor the telcos more than global players, including sectors like the development of smart cities, security solutions and other business to business solutions. Telcos are in a powerful position to be a one stop solutions provider to enterprise customers by helping them navigate this connected device ecosystem. Telcos will have to develop capabilities or partner companies with skills in business consulting and IT integration to make this possible.

Implications for System Integrators (SIs)

An important requirement for the connected device paradigm to become reality would be to stitch customized solutions to address both the consumer and enterprise requirements. This opens a new opportunity for the SIs of the world to work with ecosystem partners to design solutions such as transportation solutions for a smart city and or home delivery system for consumers. The SIs will, however, need to design these solutions with newer business models which are OPEX-based, maybe using the Cloud computing paradigm. In addition to the current SIs, we expect other players from the ecosystem and beyond like automation players, and or infrastructure players to enter the market.

Implications for Enterprises

The connected device ecosystem will enable companies to collect real time information on the usage of their products and services. This will significantly improve the quality of products, increase the pace of innovation and most importantly lead to better utilization of global resources. Business models will change from outright purchase of products to pay as you go as information about exact usage trends will be available. Insurance companies may offer customized annual premium packages based on your driving habits rather than the one size fits all approach they adopt today. The increased sophistication in cars will translate into the development of collision-less vehicles. Whilst a lot of these may sound futuristic, we strongly believe many of these scenarios will be real by the year 2020.

Mega Trend 2: Cloud Computing

There is a growing awareness among enterprises to access their information technology (IT) resources extensively through a "utility" model, a development broadly called "Cloud Computing." Cloud is the natural evolution of service delivery over a network. The biggest benefactor of this trend will be enterprises as they look at leveraging the innovation that cloud has brought to the consumer internet ecosystem. Cloud represents the next wave in the computing industry, as it strives to eliminate inherent inefficiencies in the existing IT architecture and deliver "IT as a service" to the end-users.

Cloud computing can be specifically defined as ***a pool of compute, memory and input/output resources, applications or operating environments with seemingly infinite scalability, delivered as a service over a network, be it private or public.***

There are five key characteristics that help define the cloud computing business model.

- It is ***On-Demand*** – it is available as and when the customer needs it and should be available in a self-service model.
- ***Pay-as-you-go*** – the customer needs to pay only for the specific usage for the period of time the service is needed. It is a metered consumption model and there is no payment for idle time.
- ***Rapid Elasticity*** – It enables customers to achieve scalability in their business. There are usually specific times of a month or year that there is a tremendous demand/spike in demand. Organizations no longer need to invest in building this capability if the requirement is for a very short period of the overall requirement.
- ***Shared Pools*** – It ensures optimum utilization of resources by leveraging underutilized capacity. It gives customers the illusion of infinite resources available at his/her disposal. It offers a seamless integration of computing, storage and other infrastructure resources to create a Virtual resource pool.
- ***Ubiquitous Access*** – Access is available through public or private network through any network enabled device.

The services available can be broadly classified into three distinct areas, Infrastructure as Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

	Software as a Service (SaaS)	Infrastructure as a Service (IaaS)	Platform as a Service (PaaS)
Market definition	A software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a public or private network.	A provision model in which an organization outsources the hardware used to support business operations. The service provider owns the equipment and is responsible for housing, running and maintaining it with the client typically paying on a per-use basis.	A key component of the new Cloud Computing environment, in which developers are encouraged to enhance Cloud-based services by using templates provided by the platform vendor to build their software applications.
Types of Services Offered	• Business Apps • Collaboration • Security • Office Productivity	• Computing • Storage	• Development platform as a service
Examples	• Salesforce.com • Google • Webex • Symantec	• Amazon Web Services (AWS) • Rackspace Cloud Hosting • Verizon CaaS	• Force.com • Google AppEngine • Microsoft Azure

Source: Frost & Sullivan

The final piece of the jigsaw puzzle with regards to the cloud computing business model is how it will be delivered. There are two distinct models at play – private cloud or a public cloud. Many companies may also opt for a hybrid option – some applications on the public cloud and some on the private cloud. The choice of which environment an enterprise chooses depends on various factors including company size, business sector, risk appetite, cost considerations and type of service sought. In general, small and medium customers are likely to opt for affordable public cloud services while the large enterprises will take a hybrid approach. Users also have the option to choose a fourth delivery model – community cloud. Delivered through a private network, the community cloud serves a community of organizations that have similar infrastructure requirements. Currently, community clouds are witnessing adoption primarily by the governments, especially in the US.

Our research suggests that the market for Cloud Computing in Asia Pacific (excluding Japan) has already exceeded US$1.1 billion in 2010. With a 91 percent share, SaaS is the dominant segment of the Cloud market in the Asia Pacific region. Almost one in every four enterprise is already using some form of a cloud service. Majority of customers have started off with SaaS as their first step towards embracing the cloud. Markets like Australia today lead the entire Asia Pacific region in this trend. Cloud represents an opportunity not just for the IT vendors and system integrators but also the telecom service providers. To succeed they must make the cloud as easy to use as the basic telephony service they provide.

Whilst there is the well defined trend in migration to the cloud, there are also several challenges that are hindering adoption. The primary restraint is the security and privacy issues with customers apprehensive about factors such as regulatory compliance, inadequate service level agreements, shared infrastructure (for public clouds), data storage issues, and unclear legal implications. In the absence of

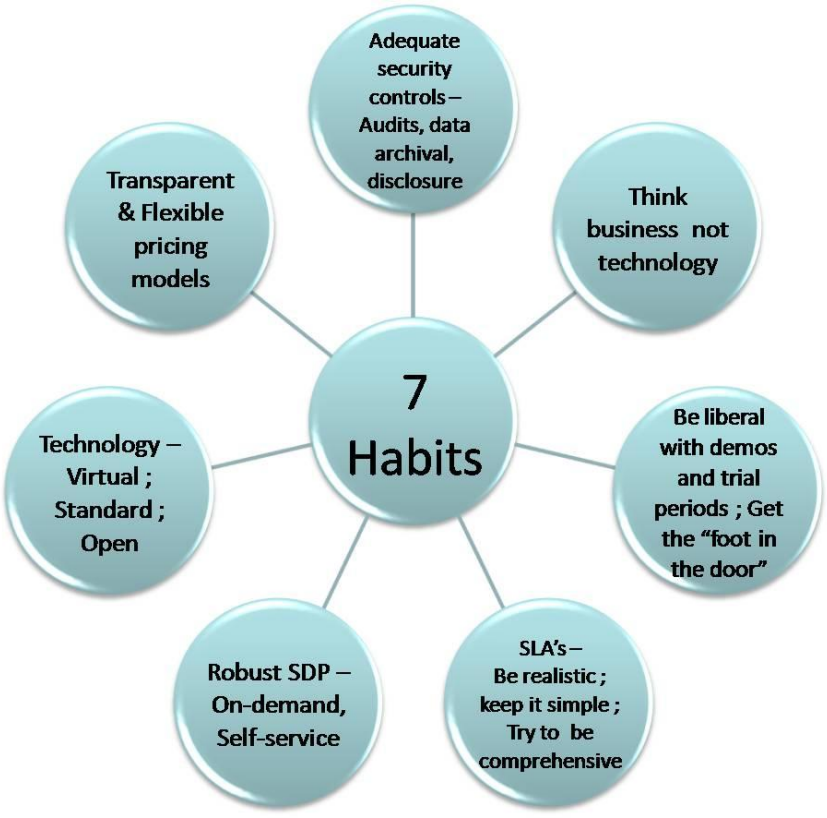
clarity on the aforementioned issues, most CXOs err on the side of caution and limit the usage of public clouds.

Cloud Computing is expected to have three key implications on the ICT industry in the long term:

- It will accelerate innovation in the ICT industry. It will reduce the entry barriers for new companies who want to offer compelling services.
- It will shake up the ICT industry over a period of time. We will see a greater participation in the enterprise market by large consumer internet companies such as Amazon, Google, Apple, and Facebook.
- The area of collaboration – (convergence of social networking, unified communications, video and mobility) will be the biggest benefactor.

For end-users, Cloud computing offers significant promise for enterprises saddled with inefficient IT infrastructure. It offers the critical promise of aligning IT with business needs and creating a truly agile business environment. It also will enable small and medium business to have access to applications that were traditionally limited to large enterprises due to the huge investments needed in start up costs.
Every large enterprise including governments should adopt a "Cloud First Policy"; they should only consider other alternatives if it is not feasible to have a cloud based service.

The Seven Habits of Highly Effective Cloud Providers

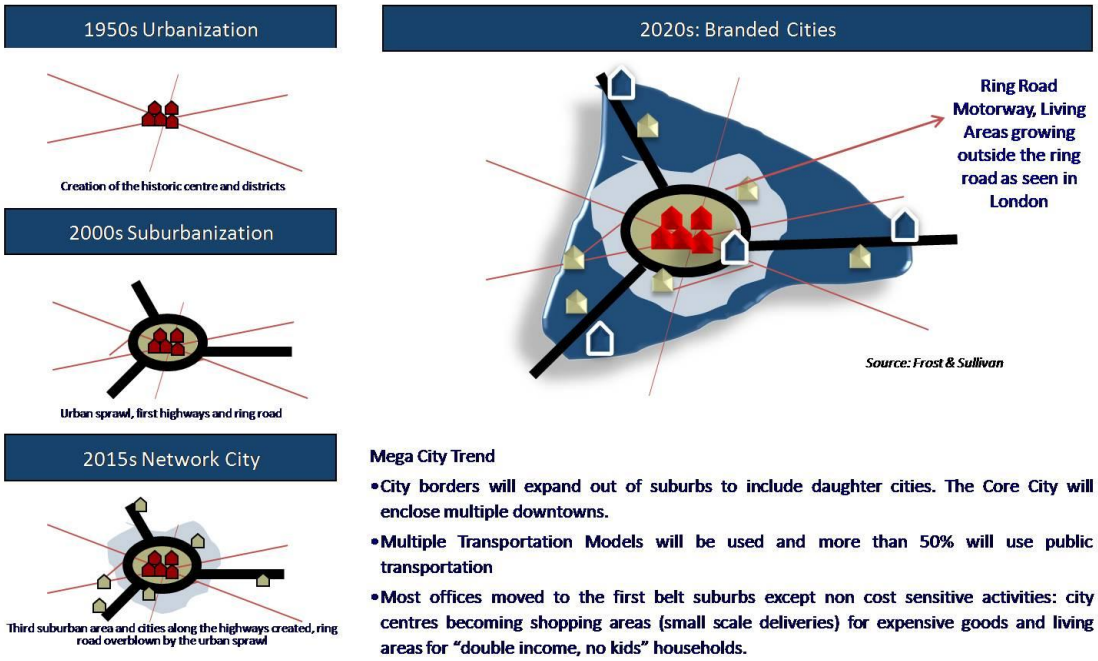


Mega Trend 3: Urbanization

Rome was one of the first cities in the world to reach a population of 1 million people. This was in the year 5 BC. It took about 18 centuries for the next city, London, to reach a population of 1 million. This trend of urbanization gathered incredible momentum in the 20th century. The primary reason for urbanization is best explained by the fact that the top 25 cities of the world today account for half of the world's wealth.

While the world population will continue to see continued growth, urbanization will happen at an even more frantic pace in the coming decades. By 2020, we expect that close to 60 percent of the world population will live in urban cities. This Mega Trend has impacted businesses, societies and cultures in the last 100 years benefitting many industries such as real estate, infrastructure, and transportation. *Frost & Sullivan* studies have shown that the rate of urbanization is much faster in developing countries. We believe that 50 percent of the top Mega Cities in the world will consist of developing countries by the year 2025.

Looking ahead into the next decade, we will see the integration of the core city centre with suburbs and daughter cities resulting in expanding city limits. Looking ahead into the next decade, we will see the integration of the core city centre with suburbs and daughter cities resulting in expanding city limits. The figure below shows the development of cities over a period of time.



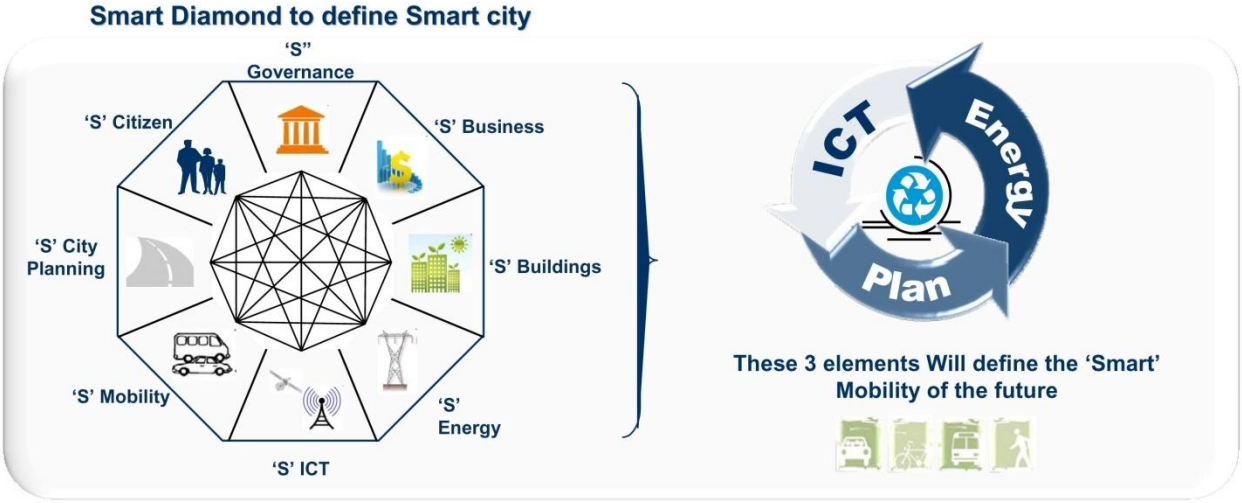
The future impact of the city development on mobility, working life and societies is going to be tremendous. We believe three concepts of urbanization will emerge: Mega Cities, Mega Regions and Mega Corridors.

- ***Mega Cities:*** Integration of core city with suburbs and housing over 8 million people and GDP of more than $250 billion in 2025.

- ***Mega Regions:*** Integration of two or more cities or expansion of city to join with adjoining daughter cities to form Mega Regions housing over 15 million people. For example Johannesburg and Pretoria (forming Jo-Toria).

- ***Mega Corridor:*** Urbanization Corridors connecting two or more Mega Cities or Mega Regions, converging to form Mega Corridors. These can be 100 km distance and having population of over 25 million living within the corridor. The Hong Kong-Shenzhen-Guangzhou Mega Corridor in China has a population of 120 million people.

Mega Cities, Mega Corridors and Mega Regions will be in a continuous race to attract the brightest talent and the worlds' best companies. As the cities, regions and corridors get crowded; they will put tremendous pressure on the infrastructure and on the planet. This will drive the trend to the development of Smart Cities. The illustration below defines the various essential components of the Smart Cities of the future.



'S' Energy → Renewable energy, Smart Grid Infrastructure

'S' City Planning → EV Charging, Smart Grid, Bus Rapid Transit, Parking Infrastructure, Congestion Charging

'S' Information Communication & Technology → Telematics, Navigation, Smart Metering, Internet Technologies

Legend: City's Infrastructure | City's User community | City's Green Ecology

The primary emphasis of the Smart City will be to increase the productivity of the citizens, enhancing its competitiveness whilst making the best use of scarce natural resources. This can be achieved through the effective use of Information and Communication Technology. Minimizing CO2 emissions will be the other important component of the smart city plan. We believe that over 40 global cities will emerge and be labeled as Smart Cities by the year 2020. Many of these cities will be from the developed markets of North America and Europe.

Many European cities such as Amsterdam, Copenhagen, Oslo and Cape Town have already done a good job in positioning themselves as green and smart cities. For example in Amsterdam, the policy makers have set an ambitious target of reducing CO2 emissions by 40 percent by 2025 (from the 1990 levels). The policy development encourages the use of public transport, imposing stiffer tariffs on parking inside the city, imposing congestion charges, yearly reduction of parking spaces in the city and enabling more charging stations for electric vehicles. Many cities have also set ambitious targets of achieving at least 10 percent of the total car population to consist of electric vehicles by 2020.

Most North American cities are focusing their efforts on the use of innovative technologies. Boulder in Colorado will be amongst the first smart grid city with an investment totaling US$100 million. Cities like Los Angeles and San Francisco will likely emerge as the hub for Electric Vehicles in America. A lot of work is currently happening in the area of water conservation, energy efficiency, waste management and low impact living. Closer to Asia, the development of Masdar City in Abu Dhabi will evolve as a research hub for green eco concepts. This city aims to be the world's first carbon neutral, zero-waste city that will be fully powered by renewable energy. The city development is being developed by the Abu Dhabi future energy company with a budget of US$22 billion.

There will also be a number of new cities which will be built from scratch that will adopt the principles of smart and sustainable development. It is no surprise that many of these new cities will be from the countries of China and India. This is being done to decongest the population from the Mega Cities and help continue the strong economic growth. The Gujarat International Tech City is being built to cater to India's large financial services potential by offering global firms access to world class infrastructure and facilities. The city planning is done in such a way that the integrated township of both residents and office is within a short radius of 5 to 10 kilometers.

A large number of global players from diverse industries such as Energy, Automotive, IT, Telecommunications, Building Technologies are making significant investments to reap the benefits from this Mega Trend. There will be a convergence of competition and we will see the entry of new players with capabilities to provide fully integrated, sustainable and customized smart city solutions.

Many of the well planned and developed cities such as Singapore are today offering their knowledge and services to other emerging cities in the areas of city planning. It is also very clear it is not possible for any one company to fully address the entire end-to-end needs of any smart city project. Companies who wish to be successful in addressing this opportunity will need to forge strong partnerships with different participants in the ecosystem.

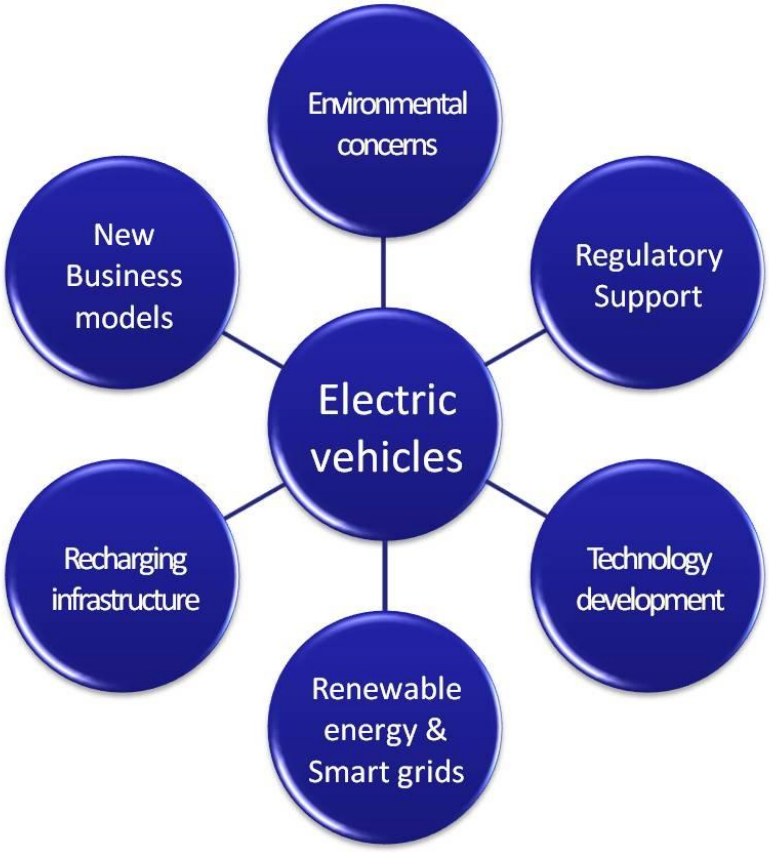
Policy makers in government agencies also see an important opportunity. In addition to doing this to enhance their city's competiveness, they believe the right policies will encourage the development of their local companies which can then succeed in the global market place. Specifically in Malaysia, there have been several projects to develop cities, townships and corridors in the last decade. Local companies have gained significant experience in developing their capabilities. The emphasis now has to be to package these capabilities in a holistic manner and market this on a global scale.

Mega Trend 4: Electric Vehicles

Electric Vehicle (EV) is a major trend that will impact the mobility of people and in turn the Automotive, Auto-component and related industries. EVs are powered by on-board storage batteries which can be charged therefore these vehicles have no tailpipe emission. Changing the source of power from fossil fuels to electricity has a very strong rationale and profound impact on multiple industries. All major automotive players have set their eyes on producing vehicles with zero emission. Reducing carbon emission in steps is seen as intermediate steps that ultimately lead to zero tailpipe emission vehicles. This Mega Trend is also built upon major convergence between automotive technology, rechargeable battery technology and renewable energy technology. It is also likely to give rise to unprecedented infrastructure development for recharging and the development of new business models in the automotive industry. These developments would also ultimately support the new mobility solutions being planned by most of the automakers.

There are several building blocks for the Mega trend like Electric vehicle to come to reality.

Building Blocks for Electric Vehicles



- ***Environmental Concerns:*** Concerns about the environment are the major driving force behind this Mega Trend. Electrical vehicles will cut down the tail pipe emission to zero. The overall carbon footprint depends on the electricity source. If the electricity is generated by renewable

energy sources the carbon footprint would be zero, while the benefits may not be as high if the source of electricity is coal or diesel. The use of electric vehicles will reduce the pollution levels in the city and have a positive impact on public health.

- ***Regulatory Support:*** Environmental concerns need to be supported and mandated by governments to bring them to reality. The extent of regulatory support and government push has direct correlation with the progress of electric vehicles in the country. Some governments in Europe have mandated the maximum carbon emission and the reduction on year-on-year basis. Failure to reach emission targets will result in high premiums to be borne by vehicle manufacturers for excess emissions.

  Governments have also supported the demand generation by supporting recharging infrastructure development and providing benefits to consumers to utilize electric vehicles. These benefits are in form of tax concessions, discounts as well as indirect benefits such as no congestion charge and assured parking.

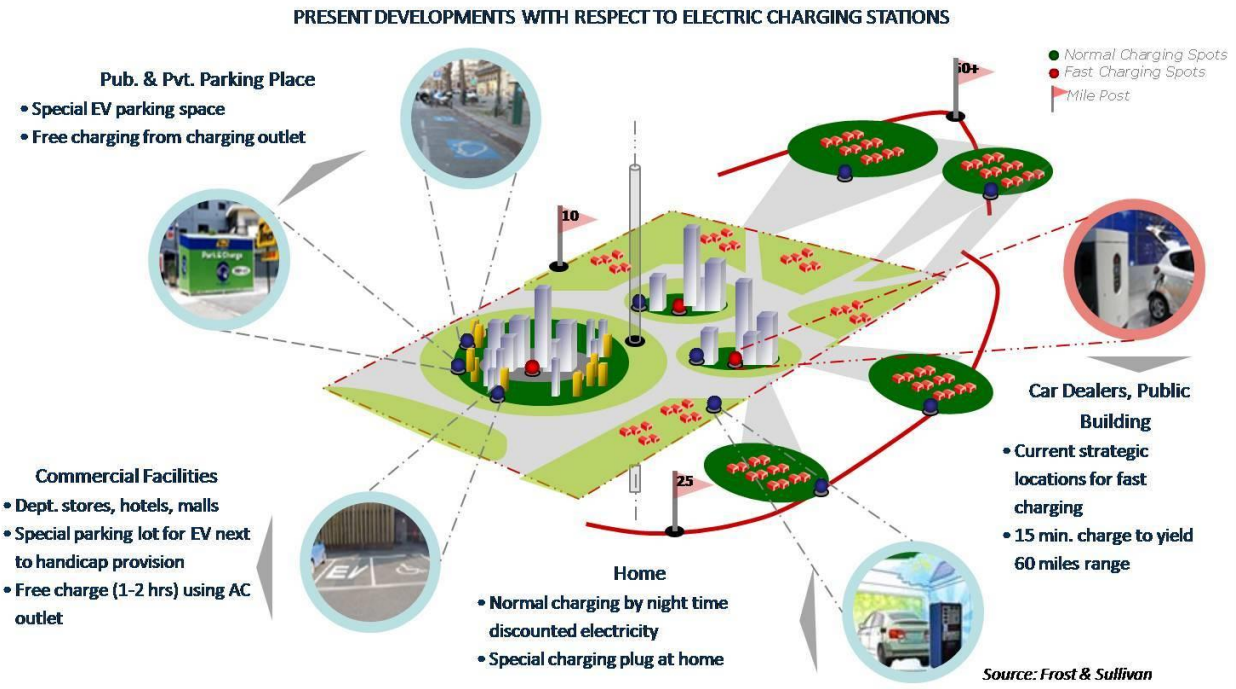
- ***Technology Advancements****:* Battery storage technology holds the key to bringing the electric vehicle Mega Trend into reality. Due to research breakthroughs in Lithium based batteries, storing power in a compact, lightweight battery has become feasible. This development combined with power electronics and electric motor technologies has made electric vehicles a feasible, user friendly product.

- ***Renewable energy source and smart grids****:* EV depends heavily on the source of electricity and electricity distribution. The more the proportion of renewable energy sources in the energy used, the more attractive the electric vehicles proposition. Recently, most developed nations have mandated that renewable sources make up a proportion of their energy production.

  Smart grids, grids that are capable of transmitting electricity both ways, are an important part of the Electric Vehicle Mega Trend. EVs, when connected to smart grids, can act as power storage devices; they can charge and store power during lean times when it is cheap and supply power back to grid during peak times when the power is expensive. This improves the performance of the grid and also earns extra cash for the EV owner, making it an even more attractive proposition.

- ***Recharging Infrastructure****:* Several types of charging infrastructure are necessary to charge EVs. At home, it can be slow charging which charges the battery overnight. At the office, a similar infrastructure can exist. However, at public buildings and shopping complexes, fast recharging infrastructure will be required. These charging points can charge the battery to its limit within 2 to 3 hours.

Recharging Infrastructure Plan for Cities



- ***New Business Model:*** Traditionally, the automotive business has always worked well with the 'own-and-drive' model. But with the advent of battery, which is a fairly expensive car component, the 'pay-as-you-drive' model has emerged. The customer can purchase the car but lease the battery and pay per km. This eliminates the risk of owning, maintaining and disposing of the battery. Electric cars will therefore be available in several packages with various options of upfront payments and monthly payments.

The EV Mega Trend is also going to result in the development of a new eco-system. The eco-system will consist of electric vehicle manufacturers, component/battery manufacturers, Utility companies, recharging infrastructure providers, governments and a new entity 'integrators'. The roles of OEMs and Battery manufacturers are well defined. Utility companies and recharging infrastructure players will need to invest in new infrastructure, smart grids and renewable energy sources. Integrators are the service providers that provide the recharging services to the customer. They will rely on Telematics to ensure that customers are able to search for the nearest charging station, make bookings or make emergency calls.

Finally, this trend is unlikely to be limited only to passenger cars. It is likely to redefine how we move. We expect several types of vehicles to emerge with electric drive. Bicycles and motorcycles driven by electricity will help us travel short distances and provide last mile connectivity to public transportation. Electrically powered delivery vehicles will reduce the carbon footprint in the logistics sector. Finally, we expect newer type of vehicles such as 2-seater electric car or travel pods to emerge in next 10 years, which will be used as city cars. Once the Electric Vehicles Mega Trend sets in the future, mobility will never be the same again.

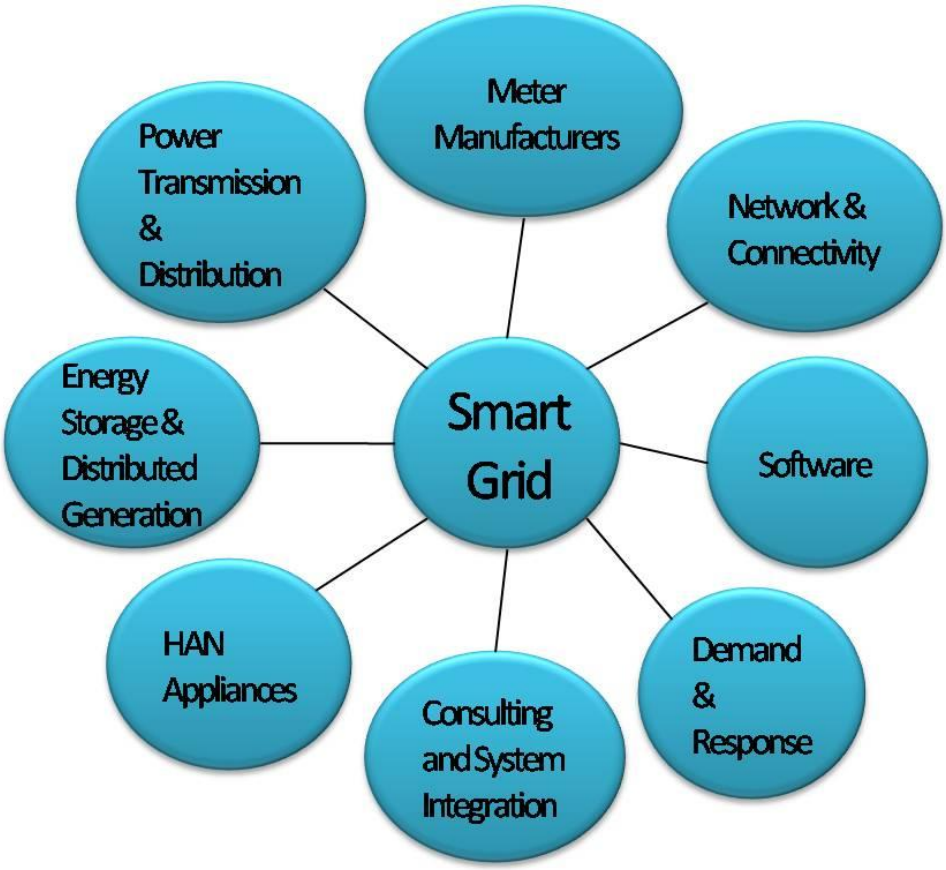
Mega Trend 5: Smart Grids

Smart Grids is the emerging paradigm in the global utility and electric power industry. The electric grid architecture as we have today is almost a century old. While there have been incremental advances in technology, there has never been a wholesale restructuring of the system. The grid is very inefficient and many a time the operator has limited real time knowledge of what is going on in the system.

The existing grid has evolved on the principle of "build and grow". The utilities have been creating infrastructure with the assumption that power demand growth will keep increasing. While this is certainly true because of the changing lifestyle and massive demand from the energy hungry digital world, the utilities have long ignored the need to strike an optimum balance between growth and efficiency. Increased concerns about global warming, pressure on bottom lines, proliferation of intermittent but clean energy sources like solar & wind in the grid, combined with advances in ICT technology, has forced the utilities to rethink their business model and technology evolution.

Smart Grids consist of a web of technologies aimed at automating, improving efficiency, and increasing availability of the electric grid ranging from generation, transmission, and distribution levels. Automation also includes tools to conduct predictive, preventative and supply analysis based on data collection that is conducted at the transmission and distribution level

Key Components of Smart Grids



From Conventional Grid to Smart Grids

The following are the key features of conventional grids:

- It is dominated by centralized power generation resulting in substantial power and transmission losses
- Ageing infrastructure in most regions are putting a strain on the grid
- Current philosophy is to do one-way metering of power consumption; this means the customers will have no control on what they consume and have no say in making choices

The emerging smart grids solution will look to address most of the inefficiencies and challenges with the conventional grids, by effectively marrying digital ICT technologies and clean energy technologies with the power grid. The key characteristics of the smart grid include:

- Advanced metering infrastructure (AMI) facilitating two-way communication between the customers and the utility
- Integrating several small generating facilities (including micro-generation) like wind & solar into the system
- Facilitating large customers like offices, hospitals to sell excess energy (they self-generate), back to grid
- Planning and supporting the large scale advent of electric vehicles. These vehicles will also store energy that can be supplied back to the grid during peak demand periods
- Increased efficiencies and reduced operational expenditures and environmental effects

Key Drivers for Utilities

The utilities in Asia Pacific are in different stages of planning for smart grids adoption. The stage of development depends on the prevailing regulatory regime in the country, level of deregulation, varying business drivers, and of course progressive thinking on the part of the company's strategic planners.

However, the following have been the broad business drivers for utilities to embark on smart grids planning.

- ***Government Mandates and Funding****:* Governments across Asia Pacific have been pushing the idea of Smart Grid through regulatory mandate as well as funding for Smart Grid implementation. Australia, South Korea and Japan have already committed a total of US$258 million for Smart Grid development. Government push is the most important reason driving the Utilities towards Smart Grid.

- ***Cost Savings**:* Catering to peak load power requirement, manpower cost and line losses are the major cost components for the utilities. In several countries, the power requirement 'peaks' at certain times of the year. To provide for this excess power, utilities have to build special power plants, which only operate for limited hours in a year. By implementing a sound demand response system, the utilities can save billions of dollars by removing the need for these plants. Manpower cost for meter reading, meter disconnection is also huge for most utilities. Also countries like Japan and South Korea are fighting with problems of an aging workforce. Hence, Smart Grid can help such utilities save cost of workforce as well as solve the problems of ageing work force.

- ***Higher Revenues:*** The US Economy currently loses US$150 billion every year due to power outages. By accurately pinpointing the outage location and rapidly responding with the use of technology, utilities can restore power and thus start generating more revenues. Also in certain competitive markets like New Zealand, where customers can switch power retailers fairly easily, companies can expand their customer base by providing better service with the use of smart grid technologies.

Mapping of Business Opportunities

- ***Metering Companies**:* Smart Meters is the most critical and fundamental part of an advanced metering infrastructure (AMI). A smart meter costs almost US$200, which is about 10 times the cost of a normal digital meter. Currently, Smart Meter Deployment presents the maximum opportunity to the firms involved in Smart Grid area.

- ***Network Communication Providers**:* A secure and robust network is required at local area network (LAN), wide area network (WAN) as well as home area network (HAN) level to ensure the interaction of the different modules of a Smart Grid and an efficient data transfer so the objectives such as self-healing, demand response control, time of use pricing etc may be met. Network layout is a major opportunity area in the AMI infrastructure as it is critical to help a Smart Meter meet its purpose.

- ***Software Solutions Developers**:* Data Management systems form the brain to analyze the wide array of data collected through a plethora of sensors and Smart Meters. Opportunities are expected in terms of one time installations, upgrade and maintenance of the software solutions for a particular utility.

- ***Integrators and Consultants**:* The Role of Integrators and Consultants like IBM and Accenture have become more crucial for pilot projects which implement multiple aspects of a Smart Grid.

- ***Automation and Sensor Vendors**:* In the process of developing a more reliable and self-healing grid, several fault detection equipment and sensors are to be deployed on the network which would only go on to make the grid more immune from outage there by reducing the power

downtime significantly. Currently, such projects have just started picking up in countries like Australia although there is an increased focus on improving Network system in all major pilot projects running across APAC.

Way Forward

In coming up with a roadmap for smart grids in Asia Pacific region, *Frost & Sullivan* has identified broad action plan for three major set of stakeholders.

- ***Governments****:* Governments across APAC have shown inclination to support the move towards a smarter grid infrastructure, at a varied pace. Exactly what features a country needs shall vary as per the country's energy policy, existing infrastructure and eventual objectives of investment. However, broadly speaking, Smart Grid in some form is increasingly inevitable for any country to meet its green growth objectives.

- ***Utilities****:* Utilities across the APAC region would need to keep a track of the following three major factors

    - Government mandates/funding making Smart Grid implementation necessary and/or profitable

    - Technological advancements in the Smart Grid area and how they affect the business case for implementing a Smart Grid

    - Different vendors/firms involved in the Smart Grid space including Metering Companies, Network Solution providers, Software firms, Integrators, and Consulting firms as well as to understand what product/service offerings Utilities would need from the vendors to help implement their own Smart Gris in the best possible manner

- **Vendors**: Vendors and firms involved in the Smart Grid area see a very dynamic market currently. The opportunity surely exists for them and to make the most of this opportunity, they would need to stay ahead of the competition by keeping a track of how regulatory, technological and business environment changes in different countries. Matching a utility's requirements would involve understanding its long term plans and coming up with suitable solutions to fulfill those plans. Given the fact that common standards are not necessarily expected in the near future, significant focus would be how well a firm can customize its products to meet the requirements of different Utilities.

Mega Trend 6: New Business Models

In the last fifty to sixty years, the focus of many large corporations was on globalization and mass production. If the volumes went up, then the unit price would go down thereby making the product more affordable for the consumer. Companies focused their entire efforts on capturing high growth as penetration levels were extremely low.

In recent years, most markets have started to mature and penetration levels have reached as high as 100 percent in several industries. Growth rates are now in single digits and with intensifying competition there is considerable pressure on the EBITDA margins. This market dynamic combined with the impact of the other mega trends such as 80 billion connected devices by 2020 will bring about a sea change in the business models for companies moving forward.

The following are four key areas which will see a dramatic change in the next decade.

- ***The Era of Personalization***: Future value creation will reside on how companies allow customers to personalize the products and services for their consumption. In the rush to achieve cost benefits from mass production, companies have compartmentalized every customer into six or seven distinct customer segments. The reality is that every customer is inherently unique and given a choice has distinct preferences. The challenge for businesses is to create the sense of personalization and meet the objectives of keeping costs down to keep the products affordable. Amazon.com is one of the world's best examples of a personalized experience where they learn about customer interests and adapts to their needs. Internet businesses have helped us understand this phenomenon and the opportunity that exists. The personalization will not just be limited to the buying experience but will move on to encompass the overall development and consumption of the product or service. Makeyourownjeans.com is an example of leveraging the internet to help consumers personalize their jeans. We are at the early stages of seeing the traditional brick and mortar companies capitalize on this trend. Companies like M&M, Nike, and Mercedes-Benz have all initiated several projects in this area. By the end of this decade it will be safe to assume that, by leveraging the internet as a medium, every brick and mortar company will be offering a very personalized experience of purchase and consumption to consumers.

- ***Co-Creation***: The internet has also helped unravel the power of open innovation. The concept of open innovation used by P&G (Connect and Develop strategy) is widely discussed as a great strategy thesis over the last several years. It helped the company leverage the innovation happening around in its entire ecosystem. The internet companies took this open innovation a step further. Customers co-create value for themselves along with the company. Online gaming and Facebook are examples of companies leveraging on this power of co-creation. Companies essentially provide a platform for its consumers to collaborate, communicate and develop value for themselves and for the consumer. This makes every other competition that focuses on developing all its capability within the corporation irrelevant. Even the biggest of corporations in the world will find it difficult to compete with the innovation happening around the world.

Telecom companies understand this better than anyone else; innovation has happened all around their network and the value creation has been captured by the likes of Apple, Google and Facebook. This is a great learning tool for companies in other industries. They need to create platforms and networks to enable their customers, partners and suppliers to collaborate.

- ***Being Global*****:** Whilst in the context of business models, it is appropriate to delve into one of the most important learning's from the next generation of companies, the internet companies. Internet companies start off with the premise of being global. The competition is global, the resources available are global, and the market is global. This in itself is a huge competitive advantage. The internet today makes every company compete globally. It will be impossible for any company in the world to state that they only participate in a particular country market or a particular city market. What keeps the CEOs of telecom companies in Malaysia awake are Apple, Google, Skype and Facebook and not their local counterparts. What will keep the CEOs of retailers in Malaysia awake in the coming decade will be Amazon.com. This will be true of most companies and most industries. The inherent advantage of starting off with a premise of being global is scale and will more importantly limit the ability to leverage global resources.

- ***Pay As You Go business model***: Over the last decade we have seen a huge shift in the strategy of organizations to focus on their core competencies. Companies prefer to not acquire assets but to lease them for their needs thus keeping their balance sheets light and giving them tremendous flexibility to scale based on business needs. This has been one of the primary drivers to the Cloud Computing business proposition in the Information and Communication Technology (ICT) industry. It is a win-win business model as it ensures greater utilization of resources. The same trend also applies to us in our personal lives. We acquire quite a number of assets which we use for a very limited extent of its complete capability. Consumers, vendors and the environment would be better off with a more efficient way of maximizing the utilization of the assets. The pervasiveness of the internet, the availability of more information will ensure this business model will become more common place in our everyday life through offerings from insurance, automotive and consumer durable manufacturers.

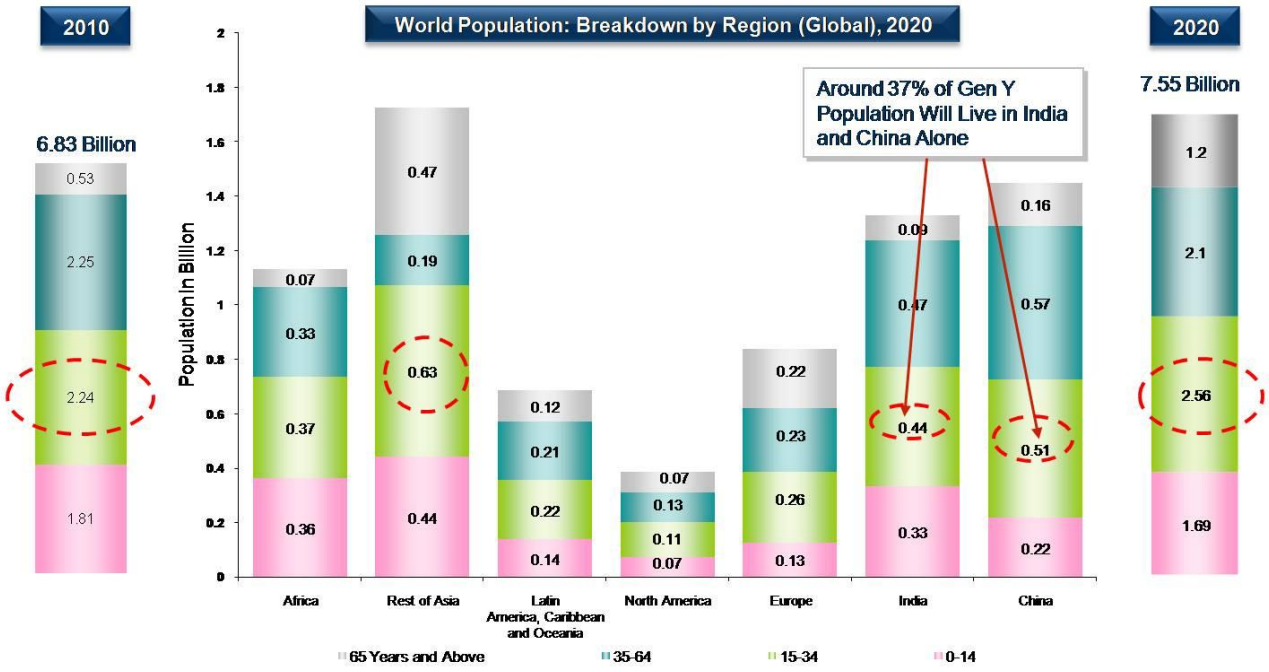
It is important to note that the four themes above are intertwined. We will be living in a hyper connected world with over 80 billion connected devices. We will be gathering enormous amounts of information from customers. This will undoubtedly help companies offer highly personalized, pay as you go offerings co-created with the customers. We can visualize a world where your insurance plans will depend on your exact driving habits, you will pay for the number of kilometers you drive on your car rather than own the car, and you will own less of everything but have the ability to use almost anything, albeit for a fee.

Mega Trend 7: Changing Demographics and Generation Y

In this coming decade, there will be some very dramatic shifts in the demographics of the global population and more specifically in the Asia Pacific region. The world population which was estimated at 6.83 billion at the end of 2010 is expected to grow to about 7.55 billion at the end of 2020. There are two very distinct trends within this population growth. The population of people above the age of 65 will grow dramatically and more than double in this period of time. It will grow from 530 million well into the excess of 1.2 billion.

This poses an interesting challenge especially for the developed markets globally, which account for a high percentage of the global aging population. It is important to note that healthcare spending by countries currently average between 5 to 10 percent of GDP. It will have to increase to between 15 to 20 percent of GDP to keep pace with growth in the aging population. An increased percentage of people above 65 will necessitate higher spending for healthcare. Per capita spending on healthcare is growing much faster than per capita GDP for most countries today and this is a worrying trend. Most nations will not be financially capable to make a commitment to this level of spending.

World Population in 2020: Out of 2.5 Billion Gen Y Population, Around 61% Reside in Asia



Note: Gen Y: Population between 15 – 34 Years

Source: US Census Bureau, 2010 and Department of Economic and Social Affairs of the United Nations

The only way to address the healthcare spending issue is to dictate a shift in spending away from treatment to predicting, diagnosing and monitoring. The focus will shift towards keeping people healthy rather than treating them when they fall sick. The Information and Communication Technology industry

or Healthcare IT, as it is popularly known, will have an important role to play in addressing this challenge and opportunity.

The other trend in demographics is specifically to do with the Asia Pacific region and the increasing importance of Generation Y (Gen Y). This segment of the population (aged between 15 and 34) will account for 33 percent of the global population by 2020. This is about 2.56 billion people. Interestingly 37 percent of the global Gen Y population will be from India and China alone. It will be closer to 42 percent if we account for the entire Asia Pacific region.

Generation Y and its importance

Gen Y is important because this generation has a completely different set of values, beliefs, interest and lifestyle as compared to the other demographic segments. Their consumption patterns and preferences will vary greatly from others and a deeper understanding is required to do well in addressing the needs of this segment. We discuss below four distinct attributes which are applicable to the Gen Y.

- ***Personalization and Individualization*:** Gen Y is accustomed to products and services which are highly personalized. They will expect a significant degree of personalization and individualization in all of their consumption and will even be willing to pay a premium for it. This is the segment that will drive the growth of companies such as makeyourownjeans.com (discussed in the previous Mega Trend) in the next 10 years.

- ***Techno Savvy and Connected*:** Communication styles have changed dramatically in the last decade; the telephone was once the primary communication medium. This then changed to email. Today almost every one sends and receives more emails than making phone calls any given day. In the last 18 months, social networking usage globally has exceeded the usage of email. It is quite possible that email as a communication mechanism will account for a very small percent of total communication time by 2020. The success of Twitter and Facebook has led us to believe and confirm that Gen Y prefers to communicate in a broadcast mode as compared to a one-o-one communication mode. There are many implications of this for businesses. Call centers will be rendered irrelevant. The shift in spending on advertising from print to these web 2.0 mediums will happen at a much faster rate moving forward. Every organization will have dedicated teams to manage their communication through social media.

- ***Civic and Environment Friendly*:** This generation is growing up with a great degree of awareness about the importance of taking care of Planet Earth. They will choose eco-friendly transportation modes, use paper-bags instead of plastics and may never print any document. They will look out to ensure that the products they consume are manufactured by companies that are environmentally responsible.

- ***Demanding, impatient and global*:** Gen Y is growing up on instant messaging. They expect immediate solutions and constantly multi-task; the overall pace of doing things will be quite fast. They are unlikely to have the patience to hold on a call, waiting for the call center agent to

pick up after five or ten minutes. They will have a much better global perspective and operate more collaboratively.

These are just some of the attributes of Gen Y. It has an impact across almost every department of the company. The level of impact will vary depending on the industry it participates in. Some of the near term impact on various functional divisions in a company are:

- ***Human Resource*:** We have already seen very high attrition levels in markets like India, China and other developing countries. Retention and employee engagement strategies have to be very different.
- ***New Product / Development*:** We will need to develop new products and services to meet the demands of personalization that this generation is increasingly getting used to. New business models incorporating the trends of co-creation and Pay-as-you-go will be critical for achieving high penetration and success.
- ***Go-To-Market*:** Given their penchant for being early adopters of technology, it is critical that organizations meet them on their own turf.
- ***Customer Relationship Management (CRM)*:** Whilst they are highly impatient, they are very used to self-service. They also turn to social media to help shape their consumer decisions. They look to members of the online communities on what products and brands are worthwhile. A negative tweet of one bad customer experience has the potential to influence thousands if not millions of consumer opinions.

While organizations can slack on the areas of new product development and Go-To-Market, Human Resource and CRM are immediate, critical needs. Negative comments by an irate employee or dissatisfied customer on an online community, if not addressed immediately, will cause long term damage. There is a high degree of risk in inaction.

Mega Trend 8: Increasing Commercial Satellite Availability will Fuel Innovation

The space industry is expected to be even busier in the coming decade. Whilst space satellite solutions are not as competitive as terrestrial solutions they will play a complementary role to meet the connectivity needs of the next generation. *Frost & Sullivan* research suggests that close to 927 new satellites will be launched by the year 2020. In the past decade, a majority of the focus of satellites were on defense and military applications. In the future, however, there will be a big shift towards commercial applications.

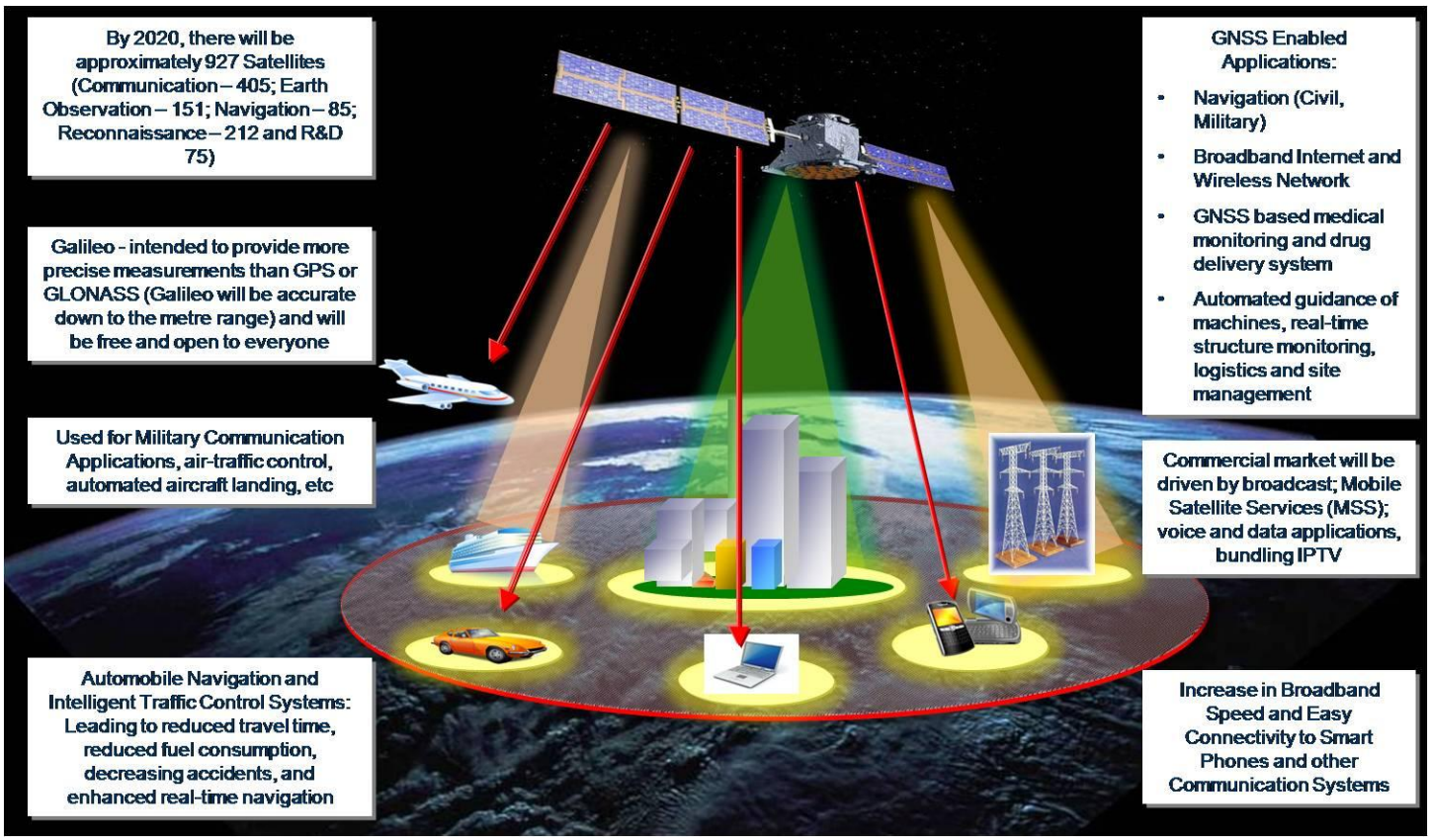
Satellites for communication applications will dominate the market, accounting for over 40 percent of all new satellites. Even with the limited use and penetration of satellites, applications such as Google Maps have changed our daily lives. The increased availability of commercial satellites will drive explosive growth in the development of innovative applications that will have a transformative impact on businesses and personal lives. Some of the key trends are discussed below:

- ***Consumer-Driven Demand*:** Even in economically challenging times, the space industry has proven resilient. This resilience to the effects of economic and political turmoil is due to the diverse customer base for space-enabled services, from commercial telecommunications to weather forecasting, global transport networks, military operations, civilian emergency services and environmental monitoring.

  Space technology, especially satellite broadband, has advantages in areas where optical fiber is not available or not cost-efficient. The use of hybrid broadband techniques, consisting of copper wire, optical fiber and satellites, provides unique solutions for bridging the digital divide, especially in rural and remote areas of developing countries.

  The space sector's growth mantra in the Generation Z world will be defined by end user-driven applications, including satellite broadband (the main aim is to achieve seamless connectivity anywhere, anytime), satellite broadcast (the 3-D revolution is still in its infancy stages), satellite navigation (from route planning, to autonomous aviation, and why not other transport modes?), to future sports such as rocket race, and Earth observation (tracking deforestation, accurate weather forecasting, monitoring carbon footprints, disaster monitoring and assistance). The space industry will continue to grow as a reliable mode of global information exchange, making it integral to the total connectivity solution.

New Satellites Launched By 2020: Over 900 Satellites to Be Launched Globally This Decade Creating Multiple Innovative Applications



- ***Shift to commercial business models*:** The recent challenges from the global economic downturn has led to most of the developed space-faring nations to consider new commercial models to meet the national space needs, both satellite and launch. The European Union has historically been in favor of a commercial (or most likely a Private Public Partnership, PPP, or Private Finance Initiative, PFI) solution to developing space infrastructure, even though it has not always worked that way; Galileo is an example of this. *Frost & Sullivan* expects PPP/PFI models to become a norm in future government space procurements.

  When considering space projects for military end-users, the challenge is even more complex. Military satellite projects involve privacy and state control, and, importantly, its continuous and stable service must be ensured. Governments are extremely cautious in engaging the private sector in this arena. However, the future Mega Trend in this regard is defined by projects such as the UK's Skynet-5A program, which is a military communication satellite system whose investor is not the government but Astrium Services (EADS). However, the government purchases the services from Astrium Services. *Frost & Sullivan*'s research suggests that space-

faring nations, especially developed countries, will adopt this model for enhancing the space capabilities of the future.

The US government also continues to rely on commercial (private) space infrastructure to meet its satellite information (communication as well as imagery) needs. Emerging from the current economic environment, the US space policy promotes a greater inclusion of commercial participants in providing services to the government end-users (both military and civil) by deploying commercial space infrastructure. This includes satellites and launch capabilities. Such policy shifts have allowed space launch providers such as SpaceX to further invest and enhance space capabilities, defining the future landscape of the space industry.

Frost & Sullivan research also suggests an increase in hosted payloads, such as the recent (2009) contract between Australian Defense Force (ADF) and Intelsat, wherein ADF purchased a specialized UHF communications payload aboard an Intelsat satellite scheduled for launch in 2012. *Frost & Sullivan* considers the changing dynamic of the commercial models a Mega Trend that is set to redefine the space industry, thriving on commercially-driven and proven space infrastructure, and reliably delivering satellite services to government end-users.

- ***Space Tourism*:** Virgin Galactic, Boeing, Armadillo Aerospace, XCOR Aerospace, Bigelow Aerospace, Galactic Suite, and Orbital Technologies are some of the companies working progressively toward establishing space tourism as a commercial reality. Recently, Boeing and Space Adventures partnered to offer commercial spaceflight opportunities by 2016.

  Richard Branson (of Virgin Galactic) has also announced plans to launch by 2012 the first space shuttle passenger; Russian company Orbital Technologies intends to build the first hotel in space and operate as early as 2016; and the first full-scale space hotel module by Bigelow Aerospace, the Sundancer, is scheduled to take flight by 2014. Considering that nearly 330 people have made deposits totaling US$45 million to reserve flights with Virgin Galactic, space tourism is expected to become a reality soon and thrive in years to come.

  Eventually, as interest grows and passenger footfall increases, the price is expected to get within an affordable price of a wider population (albeit still considerable high earners). The tickets are currently priced at US$200,000 for Virgin Galactic; other suborbital flights include Rocketplane for US$250,000 per person and XCOR for approximately US$95,000. Industry experts are contemplating an industry potential of at least US$1 billion by the start of the next decade. By 2030, *Frost & Sullivan* expects space tourism to become a notable contributor to the overall space industry revenues, with continuing potential to grow further.

- ***Space Energy*:** Space-Based Solar Power (SBSP) satellites are under consideration as a feasible energy alternative. Japan Aerospace Exploration Agency (JAXA) plans to launch a small satellite fitted with solar panels in 2015, and run a test beaming the electricity from space through the ionosphere, the outermost layer of the Earth's atmosphere, according to the trade ministry document. The Japanese government hopes to have the solar station fully operational in the 2030s. Under this project, Mitsubishi Electric Corporation and IHI Corporation are leading a

US$21 billion Japanese project intending to build a giant solar-power generator in space within three decades and beam electricity to Earth. Solar Energy, a private firm, is developing a SBSP system with a similar, if not earlier, timeline.

In 2009, Pacific Gas & Electric (PG&E), an energy utility, announced a deal to purchase 200 megawatts of electricity from Solaren Corporation, which plans to beam the power down to Earth from outer space beginning in 2016. *Frost & Sullivan* understands that although SBSP is still nascent, substantial investments by stakeholders (both government and commercial) are driving it toward becoming a crucial source of energy in the long-term (as early as 2030). Considering the energy scarcity that the world is faced with, this solution could be a Mega Trend to follow and watch for.

Frost & Sullivan suggests that satellite manufacturers work closely with the key stakeholders developing and promoting this technology to develop satellites that can deliver solar energy to Earth and also utilize the solar energy to extend the life and power for future satellites. There is a whole set of technologies and product innovation that will drive the successful implementation of this energy solution. This brings new opportunities across the value chain for the space industry, from solar panel innovation to capture and transmit the energy, to creating satellites (and subsystems) to deliver this solution, and finally the launch capacity to accommodate/deliver the next generation satellites.

The stage is set for a very exciting decade for the satellite industry how it will enable a wide range of innovation across various aspects of the industry ecosystem. The new business models will enable several new market participants to gain access to the satellite capabilities and fuel innovation in consumer applications.

Mega Trend 9: Top 10 Technology Platforms to Watch Out For

The key to assessing the true market potential of any technology lies in understanding the capabilities it offers and the type of impact it has on markets, i.e., evolutionary, revolutionary or disruptive. In order to identify the Top 10 core technology platforms currently in laboratories that are likely to have a significant impact over the next ten years, *Frost & Sullivan* has paid close attention to the Valley of Death phenomenon and also the Diffusion of Innovation process. The Valley of Death is a term that is used to indicate challenges that technologies face when they go through the transition phase from basic research to applied Research & Development. It is estimated that 80 to 85 percent of technologies developed globally never make it to the commercial world due to their inability to cross the Valley of Death.

On the other hand, the Diffusion of Innovation process provides a deeper insight into how technology evolves over a period of time. What the Diffusion of Innovation tells us is that technologies that have broad applicability and address the needs of many applications provide a longer term growth opportunity for investors. The rate at which different markets/applications adopt them varies, but their use across industries makes them a worthwhile investment target. The technologies that made it to the final Top 10 list found broad applicability across the industries.

- ***Nanomaterials***: This is a field that takes a materials-science based approach to nanotechnology. Nanotechnology is the study of manipulating matter on an atomic and molecular scale. Generally it deals with structures sized between 1 to 100 nanometer in at least one dimension, and involves developing materials or devices possessing at least one dimension within that size. Nanotechnology holds tremendous potential for the development of nanomaterials and their uses in industries such as electronics, automotives, aerospace, food, energy and medicine. These industries are looking seriously into the full-fledged integration of such materials into various applications. Graphene, touted as the "next star" of Nanotech world, has inherent qualities that might make it a serious competitor for carbon nanotubes (CNTs). This material is expected to be 1/9th the cost of CNTs and is expected to garner a lot of interest from investors in the near future. Most of the R&D efforts in nanocomposites are focused on the integration of carbon nanotubes (CNTs) or inorganic nanoparticles into polymer matrices. Nanotubes and nanoparticles have seen many years of research and development effort on a global scale.

- ***Flexible Electronics***: This is a technology for assembling electronic circuits by mounting electronic devices on flexible plastic substrates. The sheer volume of areas in which this technology space can have an impact is phenomenal. By 2018, we can expect applications such as printed sensors and displays in packaging, Flexible User Interfaces, Flexible RFID for ticketing, Clothes with sensors, advanced paper based GUIs for small computers, Flexible displays for computers and televisions, as well as Flexible and washable textiles with embedded electronics.

- ***Advanced batteries and Energy Storage***: The applications for this are evolving with demands for higher power requirements at lower costs. There is a number of promising technology

platforms that can address the requirements; however the cost versus performance inflection point has yet to reach the optimum level. The applications are diverse across various industries. The electric vehicle industry will be one of the key drivers in the near term.

- ***Smart materials***: They sense changes in the environment and respond in a predictable manner. This opens up new possibilities such as clothes than can interact with a mobile phone or structures that can repair themselves e.g. the development of Self-repairing plastic products. The Exotic Materials Institute in UCLA, Los Angeles has developed a transparent plastic that if fractured will mend itself when heated. Yet another interesting area is in the development of smart polymers for bio medical applications. These materials can respond to external stimuli such as heat, pH, light, electric field, chemicals and ionic strength by itself. The use of smart materials instead of traditional ones to sense and respond can help reduce weight, simplify the devices and thereby limit the chances of failure. Within the various types of smart materials, piezoelectric materials are expected to be one of the fastest growth areas.

- ***Green IT***: Energy required by the Information and Communication Technology (ICT) companies will be one of the biggest challenges of the coming decade. Talk to the CEO of any internet company and energy will come up as one of the biggest areas of concern. Governments, standards bodies and industry leaders are actively involved in developing technologies that can improve the overall efficiency of data centers in particular. The economic recession has emerged as an unlikely driver for greening data centers.

- ***Solar cells or Photovoltaic technology***: This has attracted the highest interest amongst venture capitalists in the renewable energy space. Module prices have been declining rapidly and this is enabling large scale deployments. Across the different generations of PV technology, we see a greater amount of market demand and focus around CIGS (Copper Indium Gallium diSelenide) solar cells based on the potential of higher efficiency and environment friendliness.

- ***3D Integration***: This is an intriguing topic and considered as the next big thing in the electronics industry. It is an emerging technology that can form highly integrated systems by vertically stacking and connecting various materials, technologies and functional components together. The benefits include increased performance, reduced power, small form factor, reduced packaging, increased yield and reliability and reduced overall costs. Market segments that are expected to leverage this technology include Image Sensors, Memories, Microcontrollers/Microprocessors, Portable Medical Devices, etc. On the flip side, 3D Integrated Chip technology at this point of time has not yet evolved to be cost-effective. The true potential of the technology will be realized when the technology price performance barriers are broken.

- ***Autonomous Systems***: This is an interesting entry into the Top 10 list. Unmanned Aerial Vehicles (UAV) and Autonomous Land Vehicle (ALV) are the key entities of focus for

autonomous system development. Although the technology is primarily being developed by militaries across the globe, its potential impact on the market place and our lives through the Diffusion of Innovation process is going to be immense. For instance, the booming UAV market has expanded rapidly in the past one year and continues to do so with hundreds of designs competing for both military and civilian contracts. UAVs were the fastest-growing segment of the aerospace sector in 2008, and valued at close to US$3.4 billion worldwide. Given the progression of autonomous technologies, it is expected to logically drive the future of aviation and urban transportation by 2030 to 2040 as we would probably see the use of flying cars in the very cities that we live in today!

- ***White Biotech***: This involves the use of micro-organisms and biological catalysts (like enzymes) to the production of bio-based chemicals, materials and fuels. As of now, the industrial applications that leverage its capability include bio-feedstock, bio-process and bio-products. It is considered by many as a "hidden solution" and its sales are expected to further grow significantly and increase their share of chemicals production. More importantly, the technologies and sectors growth is driven by advantages along all 3 dimensions of sustainability - people, planet (less emission, less energy consumption) and profit (low cost, low risk).

- ***Lasers***: Laser technology arose from research carried out in Bell Laboratories in California in the 1950s to develop a tool for the investigation of molecular structures. However, given the multitude of applications in which it is used for, quick estimates suggest that global revenues from the sales of lasers was approximately US$7.5 billion in 2010. Although, the laser market is mature, there are constant developments related to materials, sub-systems, and control systems of lasers that make it an evergreen and evolving landscape. It also stems from the fact that lasers are an “enabling technology” i.e. they enable development of other “platform technologies”. Therefore, there is constant demand perceived for novel laser capabilities. CO2, High power, and Fibre lasers are some of the fastest growing sectors within lasers.

The overall pace of innovation is expected to be very rapid as the internet has enabled institutions and organizations to collaborate effectively across the world. We also see a greater degree of public – private partnerships. Companies and R&D institutions would do well to prioritize their investments based on these top technologies. For example, there are several industries such as rubber, palm oil, as well as Oil and Gas that Malaysian companies have a strong global and regional position in. It will be important to analyze the impact of these technologies on the industries that Malaysia plans to play a prominent global role in the coming decade. The right partnerships with global institutions with a strong play in these areas will ensure local companies will have access to the latest findings and achieve global competitiveness.

Mega Trend 10: The Growing Importance of Information and Cyber Security

On the 26th April 2011, SONY announced that personal information had been compromised on their Internet service delivery networks, the PlayStation Network (PSN) as well as image and music distribution service, Qriocity. A total number of 77 million users had their personal information such as user name, ID and online password stolen. A week later, on 2nd May 2011, a second security breach happened with a different SONY network. This time round, the target was the SONY Online Entertainment (SOE) network and the compromised figure of data loss hit 24.6 million users, of which 12.3 million had their credit card information stolen. Shortly after, a third incident involving the loss of 2,500 users' names and addresses took place, with the source of the leakage coming from the electronics arm of SONY.

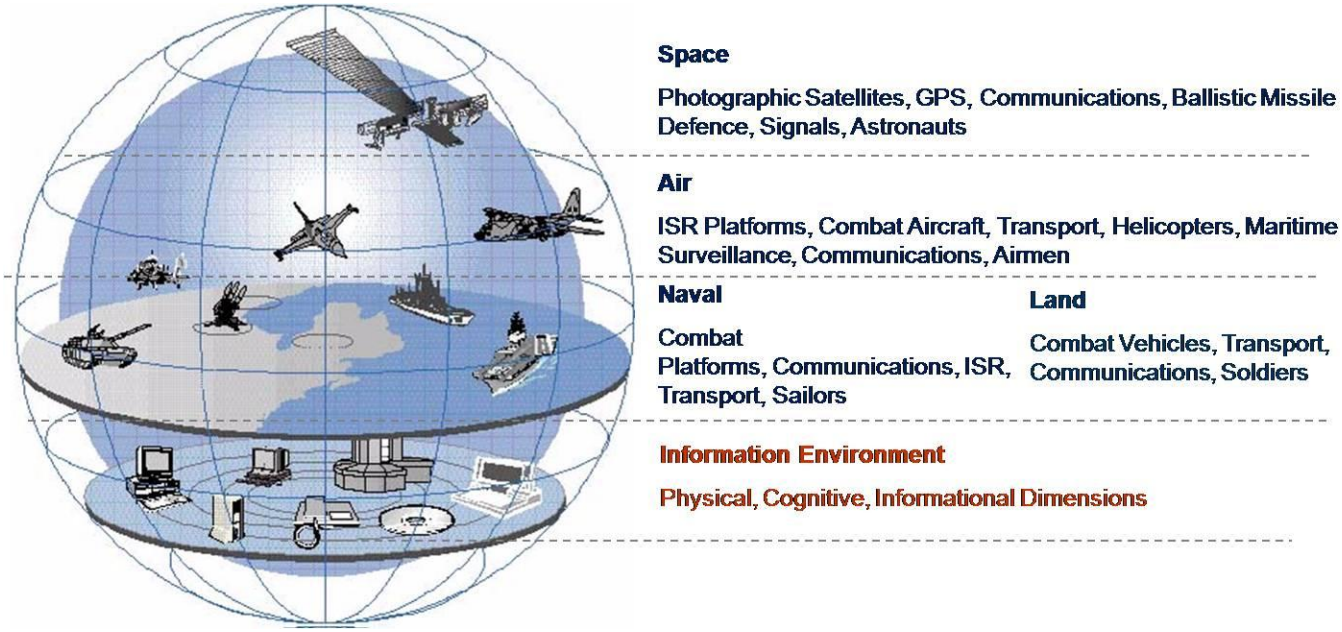
Three security breaches in three weeks, all of which amounted to an unprecedented figure of more than 100 million users having had their personal information stolen. This was undoubtedly a world record of sorts in the history of data loss incidents. More importantly, the nature of the incidents, all of which involved the loss of confidential user information, showed that the stakes associated with security breaches had become ever higher.

Concurrently as we look at nations, Cyber Warfare is gaining considerable importance. The information environment adds to the complexity of modern warfare, which now consists of air, land, sea, space and (the non-geographical) information domains. Its dimensions are composed of physical infrastructure, stored information and information processes, as well as human decision-making. It is therefore a mistake to limit the study of information operations to the information dimension since they have a much bigger role to play in the physical and moral areas of strategy. War should now be seen as being conducted in five domains: in the air and in space, on sea and on land, and also in the information environment.

Cyber warfare is becoming more and more powerful in today's battlefield. Effective use of cyber technologies can gain dominance on the battlefield or force the enemy to retreat by shutting down its command infrastructure or communication network. The role of Cyber Warfare is seen to be growing due to the digitization of conventional warfare technologies as well as using more complex devices to do more damage than they could in past.

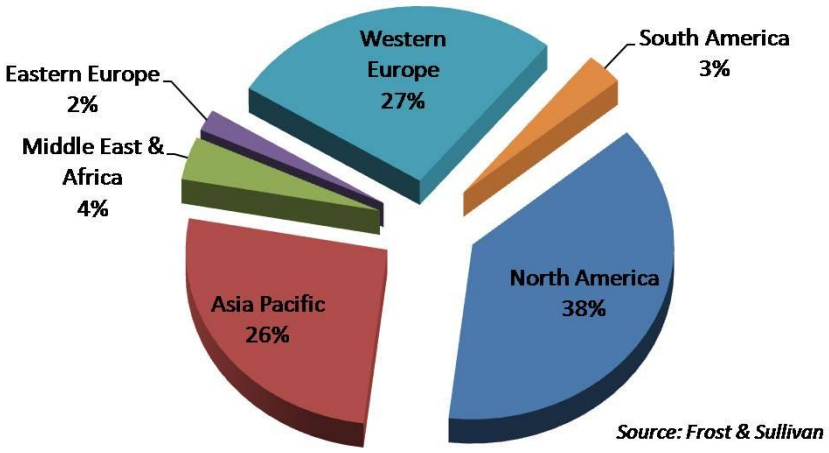
Whilst discussing about nations, Cyber Warfare is not just limited to governments attacking governments. Any part of the critical infrastructure may be subject to attack, from banking and utilities to transport or the supply of essential goods and commodities. "Cyber Threats" include every threat that can be carried out over the internet. Cyber crimes cost countries billions of dollars every year. They can also have catastrophic impact on personal lives as was seen in the case of the crash of Spanair flight 5022 in 2008, where 154 people died. Reports seem to suggest that the Central Computer system was infected with Malware which resulted in it not picking up 3 technical problems.

World War 3: With Advancement in Technology, Information Warfare to be the Next Domain of Conflict



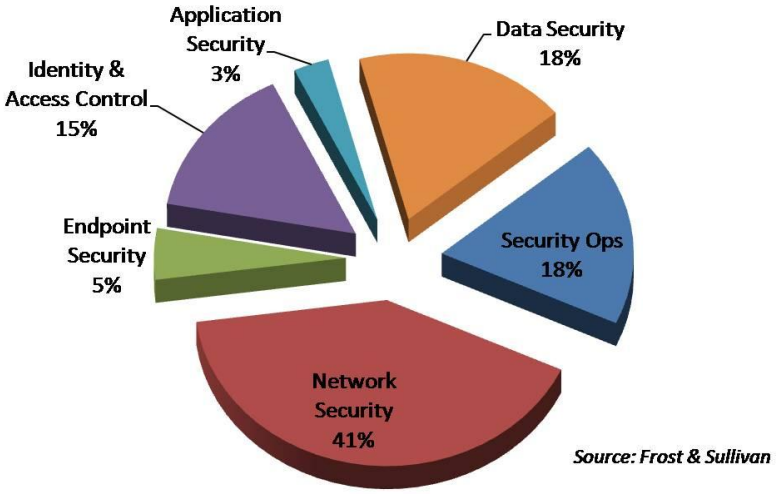
As we look into the future, in a world of tens of billions of connected devices and the increasing integration of the internet into every single aspect of our lives, the risks will only increase. Whilst IT spending globally has increased dramatically in the last decade, Cyber Security related spending has increased at a higher pace. Organizational spending on IT security has increased by 50 percent in the last three years alone. There are considerable variations in security spending across various regions.

Cyber Security Market: Spending by Regions, 2010



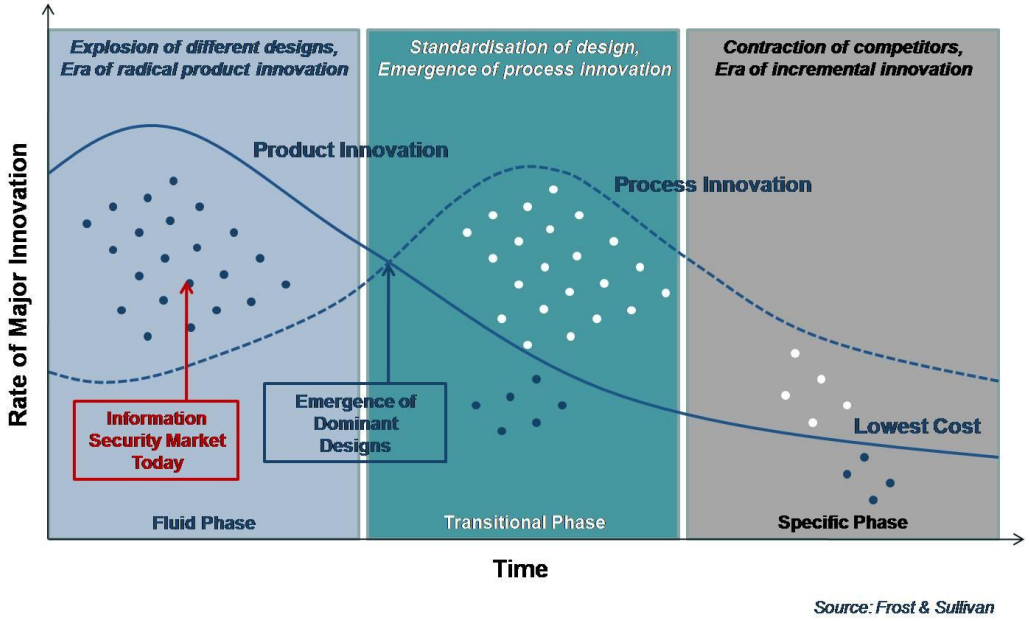
The current spending on information protection also seems to indicate that Network Security, Security Operations and Data Security are the highest areas of spend. Moving forward, Identity and Access Control, followed by data security will be the fastest growing segments.

Cyber Security Market: Spending by Solution Segments, 2010



With a long-term goal of achieving cost effective solutions, companies and governments are increasingly funding R&D. Driven by the increase in the dependence on information, the cyber security market will witness an unprecedented growth in the next decade. Aggressive Product Innovation and Improvement will drive wider adoption of cyber security solutions. Governments and Militaries will drive this market as early adopters, followed by the commercial sector once the products and solutions are tested and much more accessible and affordable.

Cyber Security Market: Market Evolution



Implications

As we look into the future, we will be increasingly dependent on Information Technology for success of our businesses, success of government and success at war. This Mega Trend will therefore have far reaching implications on society.

- At the very minimum, a country should have a very strong Cyber Warfare unit to ensure the country's survivability, prosperity and stability. In the past, countries relied on strength of conventional military units but now the future of a country may depend on how well trained its Cyber Warfare units are and how secure its cyber operations are. Most people underestimate the havoc that true cyber terrorists or hostile nations engaged in information warfare can inflict on a country. Governments must expand institutions that respond to security breaches; expand both formal and informal mechanisms for international cooperation in the investigation and extradition of cyber attackers; and invest in basic research that identifies the fundamental principles that underlie complex, interconnected infrastructures.

- This is a high growth market. Providing end-to-end security solutions will be essential over a period of time. As such partnerships with other players in the ecosystem as well as with scientific research organizations, national defense organizations will ensure that the industry can be globally competitive.

- Establish countries as a strong, secure and trustworthy player in the internet economy. Issues such as credit card fraud, software piracy results in countries not being highly regarded as a hub for internet and e-commerce.

- Invest in developing the human resource for cyber security professionals. There will be a continuous shortage of qualified resources with expertise in this area as governments and companies rush to build their competencies. Public-private partnerships need to be formed and incentives need to be offered to increase the overall pool of security professionals in the next decade.

Mega Trend 11: Urbanization Triggering Demand for High Speed Rail

In line with global urbanization trends, it is estimated that 4.5 billion people globally will be living in cities by 2020, representing 60 percent of the world's population. This will continue to exacerbate demand for urban transportation in these areas, which will be dependent on smart mobility networks to facilitate travel and the movement of goods and services in tomorrow's smart cities. These cities, termed as Mega Cities, will have a minimum population level of 10 million and will form as a result of the core city centres engulfing the surrounding suburbs to form one big city. This trend will create a compelling need for the increased mobility solutions.

People today are travelling much more than they used to in the last 10 years. Passengers want to reach their destination comfortably, taking the minimum journey time possible. Conventional air travel addresses the need of quick mobility in terms of the actual journey time. However, in today's urban environment, reaching the airports that are located outside the city has become particularly time consuming and unpredictable in terms of journey time for airport users. As such, there is a growing potential for a true high speed mobility solution that can connect two or more city centres in the quickest time possible.

This is where High Speed Rail (HSR) pitches in as a faster, greener and more convenient mode of transport for inter-city travelers of the current generation. The convenience factor is potentially the key advantage of HSR versus aviation, as HSR can connect major cities directly, making use of mainline rail stations, traditionally located in city centres. However, HSR also allows for the creation of new towns within the existing/expanding network (becoming future centres for industry, business and residence).

Whilst the actual in-vehicle journey time will be similar or marginally longer when using HSR, the fact that the reduced number of interchanges required to reach one's destination improves passenger convenience. In addition, the improved provision of power, internet connectivity, and infotainment on HSR allows passengers to undertake work, gaming, and various entertainment forms more easily, placing this mode of transportation in an advantageous position over aviation, and particularly attractive to business customers.

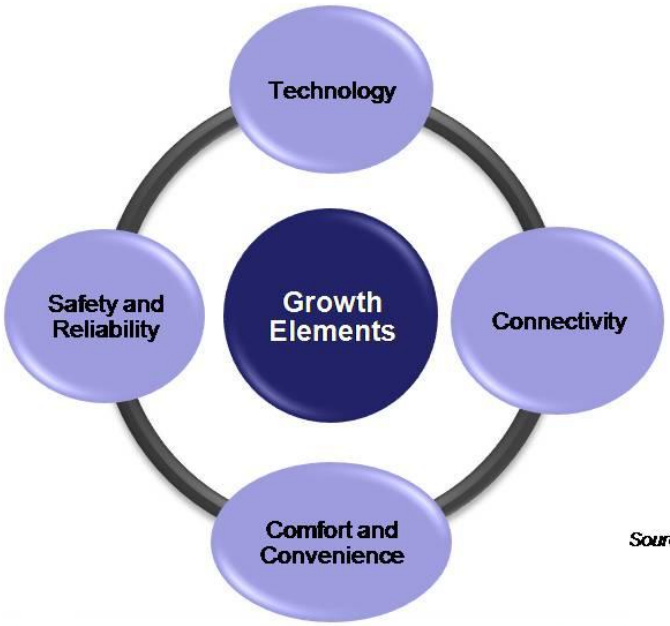
Present outlook

Japan was the first country to build and develop a high speed railway concept in the 1960s, followed by countries across Europe and Asia. Though Japan was the pioneer of high speed rail, France and Germany lead the way in Europe in terms of total high speed network and rolling stock in operations, owing to the volume of passengers and land covered by track. Until 2008, France (1,961 km) and Germany (1,285 km) were the top two unchallenged leaders globally in terms of HSR network operations, when China rolled out its HSR plans in early 2004.

Today, the global high speed rail network size is approximately 14,213 km with Europe and Asia the only two regions having high speed train operations. Asia, with 7,698 km of network operations, forms the majority share of 54% against Europe's 6,515 km of HSR network length. With 4,571 km in 2010, China

accounts for 32% of the global share and is positioned as the single largest operator of high speed rail in the world.

Urban Rail Transportation Market: Key Elements Growth (Asia Pacific), 2010-2020



Future booming markets

High speed rail is in the process of taking a new global dimension, with countries across North America, South America and the Middle East opting to proceed with their HSR plans. In the next 10 years, countries across all regions will invest US$824 billion on new rail infrastructure construction. An additional US$76 billion is forecast to be spent on rolling stock procurement across the globe over the same period. The largest investor on infrastructure development will be the United States, with an investment of US$137 billion over the next 10 years, followed by China at US$128 billion.

In Europe, Spain will invest approximately US$104 billion on track construction and rolling stock procurement, followed by France with a total of US$75 billion. By 2020, Spain, with a total network length of 5,520 km, will surpass France (4,787 km) as the market leader of the European High Speed Rail sector. Turkey will be the 3rd largest growing market in Europe, investing approximately US$59 billion in network development and rolling stock procurement. Brazil, in the next couple of years will have a 750 km high speed rail network operational to support the great influx of travelers visiting the country for the 2014 FIFA World Cup.

Asia High Speed Rail

In Asia, high speed rail is available in Japan, China, South Korea and Taiwan. Other ambitious high speed rail plans are still under discussions among Asian Governments. For example, there are plans to build high speed rails from China to South East Asia (5,382km) connecting Singapore, Malaysia, Thailand, Myanmar, Laos, Cambodia and Vietnam with Kunming and other cities in Yunnan, China.

- ***China:*** In China, the 1,318 km Beijing-Shanghai high speed rail line is expected to cut travel time between China's two major metropolises to about five hours. The line is scheduled to go into commercial service at the end of June 2011.

  Trains on the line will run at two speeds, 300 kilometers per hour and 250 kilometers per hour, with different ticket prices depending on the speed of the train. China has plans to invest 2.8 trillion Yuan (US$431.7 billion) to build about 30,000 kilometers of new rail lines over the next five years. The total length of China's railways is set to exceed 120,000 kilometers by the end of 2015.

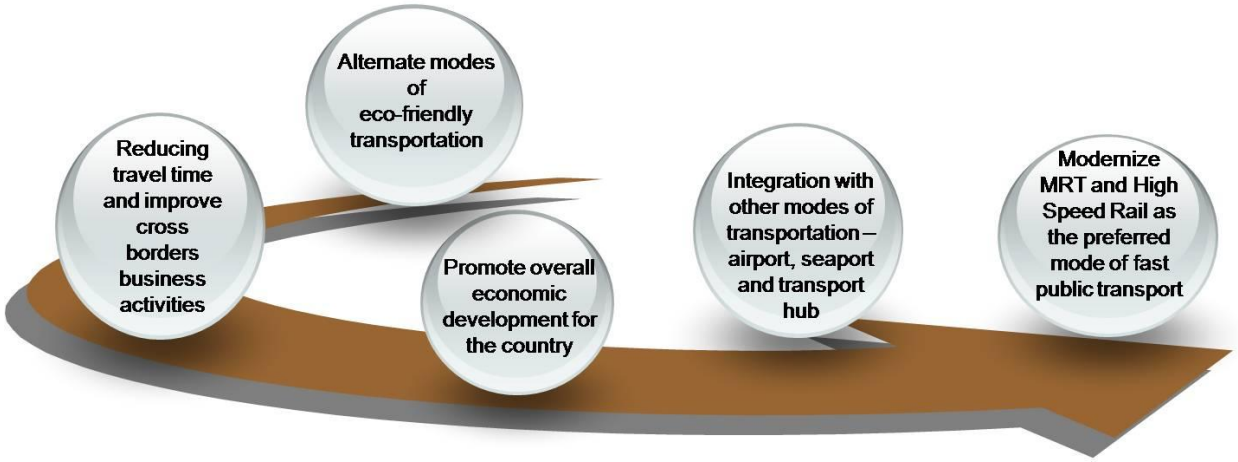
- ***Taiwan:*** In Taiwan, the Taiwan High Speed Rail Corporation (THSRC) was incorporated in May 1998 as the concessionaire to build and operate the HSR service, linking Taipei to Kaohsiung at a total length of 345km with 90 minutes traveling time. During the first stage of the operation, eight stations of the high speed rail was operated, namely, Taipei, Banciao, Taoyuan, Hsinchu, Taichung, Chiayi, Tainan, and Kaohsiung (Zuoying). In 2010, four more stations - Nangang, Miaoli, Changhua and Yunlin - were opened.

- ***Korea:*** The Korean Train Express (KTX) high speed rail train, modeled after the French TGV high speed train, was aimed at connecting locations between Seoul and Busan.

  The main line on the KTX is the Gyeongbu Line which runs between the capital Seoul and the Southern port town of Busan. Stops on the Gyeongbu Line include Yongsan, Daejeon, Milyang and Gupo.

- ***Proposed Kuala Lumpur-Singapore high speed rail link:*** The proposed KL-Singapore rail link is a very critical and landmark link that needs to be established through high speed rail to ensure better choice of connectivity to improve the ability of organizations to interact and leverage the benefits of a regional entrepot (Singapore). This cross-border link has already been leveraged by other modes of transport like air (notably low cost carriers) and road. With the next decade attributable to the growth of the services sector, a high speed rail connectivity can greatly help organizations to leverage Greater KL to establish larger offices with competent workforce, who can commute most effectively into markets such as Singapore to derive business and economic benefits. In effect, Greater KL will transform in to a service sector hub with this model, if high speed rail connectivity is available towards the north and southern directions, creating a sustainable economic profile for the city.

Benefits of MRT and High Speed Rail for Greater Kuala Lumpur

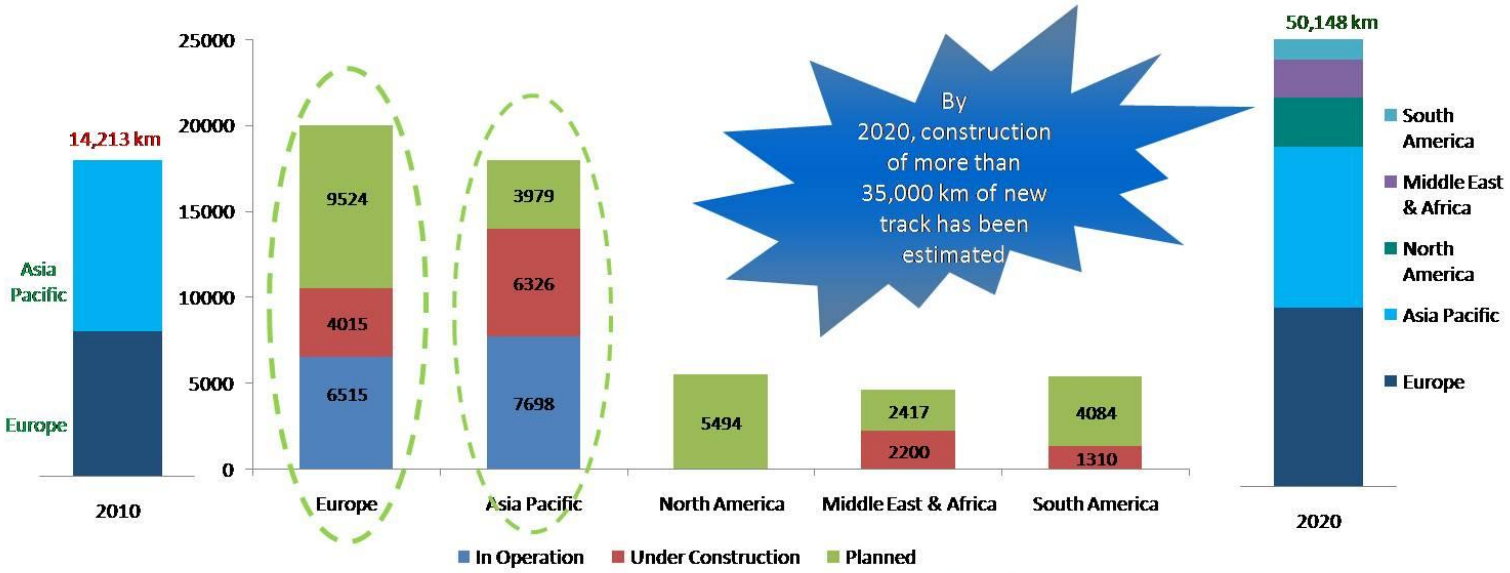


Source: Frost & Sullivan

Almost all high speed rail networks have also been promoted as a tourist experience and consequently been a must-see attraction in the city. Examples like the Shanghai Maglev, Taipei high speed rail, and Japan's bullet train have all helped support this agenda. The connectivity option in any Mega City has certainly influenced property values due to the ability of residents to save time in commuting.

Opportunities across segments

High Speed Rail Market: Network Existing, Under Construction and Planned (World), 2010 and 2020



Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

As can be seen from the figure above, Europe is expected to more than triple its total HSR network length from 6,515 Km to 20,053 Km by 2020. Existing European infrastructure and rolling stock manufacturers will face stiff competition from rival suppliers to service this increased demand, demonstrated recently by Asian OEMs like Hitachi and Rotem Hyundai, who were targeting the European market to get at least a small proportion of the market and in turn intensified competition with regional suppliers like Alstom and Siemens. Now they have new markets like USA, Brazil and Middle East to target where there is zero presence of domain specialists to address this demand.

Asian players like CRH (Chinese Rail High Speed) over a short period of 5 years have grown to a level of supplying both infrastructure and rolling stock demand within their country. By supplying to the internal demand (13,000 Km by 2014), CRH have gathered considerable experience in the High Speed sector. They plan to take their expertise across the globe to these new markets and are expected to use their low cost competitive advantage to gain new orders. Other support businesses like in-rail internet connectivity, on-board entertainment, hospitality and duty free shopping in newly constructed stations will promote the growth of entities involved in such businesses, and continue to improve the end-to-end journey experience whilst taking advantage of increased consumer opportunities.

Conclusion

Across the world, several countries such as Spain, the United States, China and the Gulf Co-operation Council (GCC) have extended firm support towards implementation of High Speed Rail. However, there are significant challenges that need to be overcome in terms of funding and resources, which is of particular importance in times of austerity following the global financial crisis. Urbanization and the development of Mega Cities will undoubtedly provide opportunities for rail infrastructure companies.

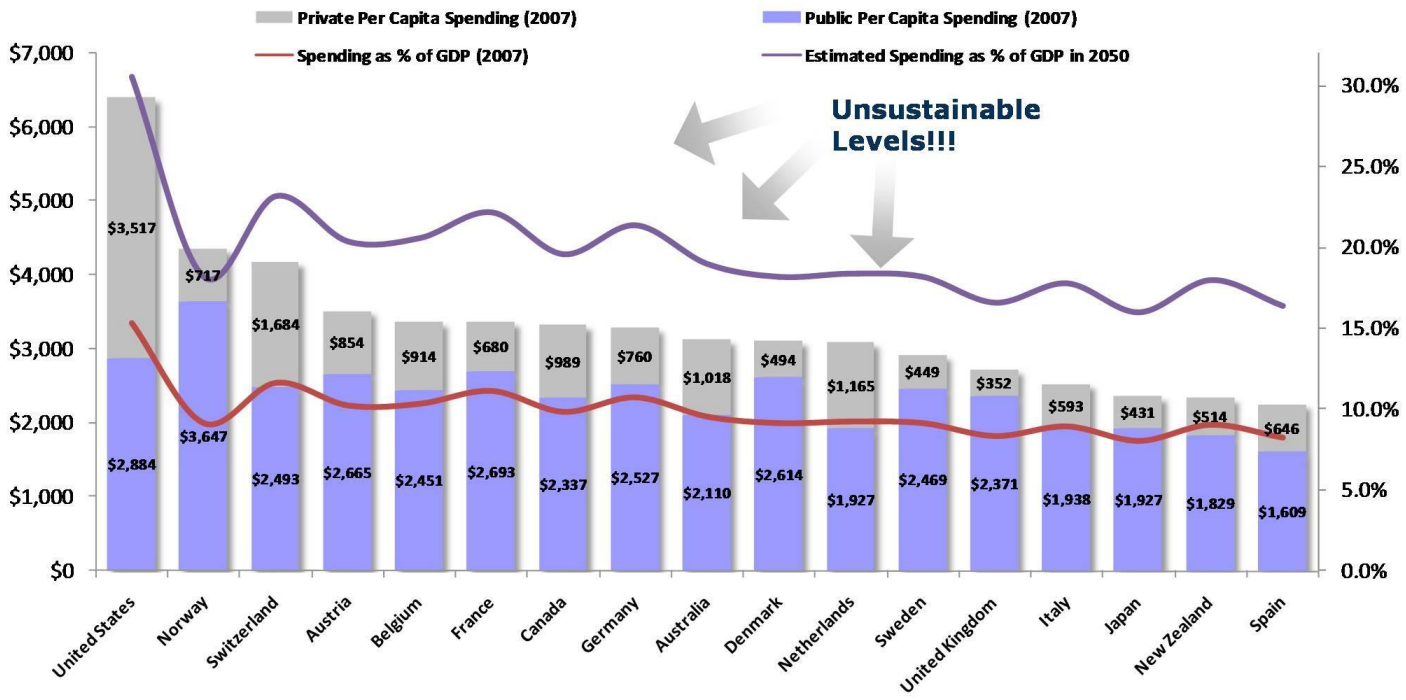
This developing scenario has tipped High Speed Rail to become the “next big thing” to address the growing mobility challenges, enabling increased competition to the aviation industry, and thus improving passenger travel and the environment. We can expect to see a rapid growth in the High Speed rail market, especially if governments follow China's aggressive commitment in implementing new high speed rail projects. China has built a network spanning a length of 4500 km from scratch in two years time and is likely to add another 9700 km before 2014.

To achieve faster, safer and greener mass transit, a mix of government and industry participants need to come together and deliver a solution encompassing budgeting, land & resource allocation and efficient production and project management.

Mega Trend 12: The Era of Wellness

In the coming decade, enabling healthcare access to all will be one of the foremost challenges that governments will have to address. This challenge is common to both developing and developed countries. Developing countries are working towards ensuring at least a minimum level of 5 percent of GDP spending is towards healthcare. Developed countries on the other hand have a challenge to manage their healthcare spending as they struggle to deal with an ageing population. Healthcare expenditure increases with age and escalate sharply as people reach the age of 60. The following chart shows the spending per capita in the developed countries and also the spending as a percentage of GDP.

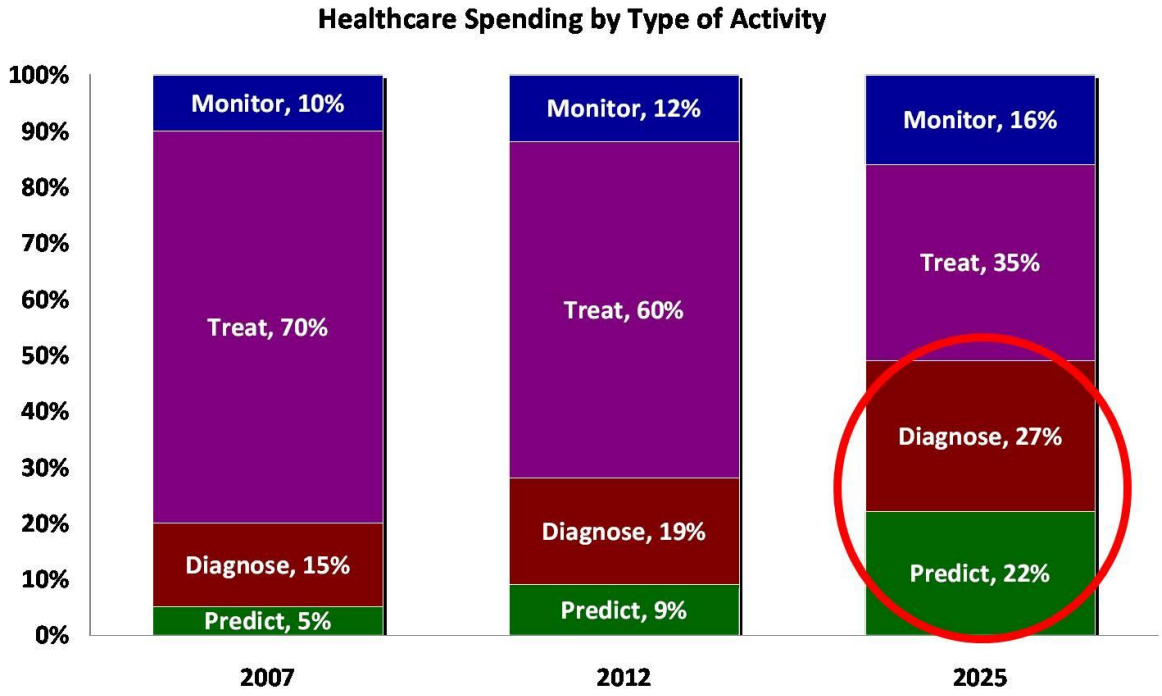
If Current Trends Hold, By 2050 Health Care Spending Will Almost Double Claiming 20% – 30% of GDP for Some Economies



Today, the average spending ranges from 5 percent to 10 percent of the GDP in most countries. With the growing ageing population, the per capita healthcare spending is rising faster than per capita income. The situation is further exasperated with the tough economic environment in many of these developed markets today. If countries continue to adopt the current approach towards treatment, the spending levels will have to more than double to 10 to 20 percent of the GDP. This will be unsustainable for governments and citizens. The only way to tackle this is to change the focus from treating to keeping people healthy.

Currently, all of the emphasis on healthcare systems is to treat people when they fall ill. We visit doctors and hospitals after we have contracted an illness. Looking into the future, we will visit doctors

and hospitals with the objective of staying healthy. This, the industry believes will help substantially reduce the overall cost of healthcare. For the industry this will mean, a shift from treating to Predicting, Diagnosing and Monitoring. The following chart illustrates how this shift will happen over a period of time.



This shift will manifest itself in the development of a new healthcare model based on 4Ps:

- ***Preventive*****:** Moving from healthcare being sick-care to wellness by providing means for preventing disease on-set.

- ***Predictive*****:** The amount of genetic data being harnessed globally will help predict the medical conditions that a person is susceptible to. Potential development of "Socio-eco-genetic" classes allowing the next P – personalized.

- ***Personalized*****:** Mechanisms for prevention, early diagnosis, and treatment can be personalized based on an individual's genetic make-up, co-morbidities, potential side-effects, and more, providing better efficacy.

- ***Participatory*****:** The patient-centered model of healthcare will now become the healthy-individual–centered model of healthcare. The individual now is far more informed than ever before. He/she maybe incentivized or penalized as the case may be thus drawing away some responsibility from the care-giver to the receiver.

The change in the healthcare model will manifest itself in an individual being more empowered and responsible for his/her well-being. The onus is on the individual to prolong his/her healthy state as opposed to being at risk or worse, a patient. This will effectively bring about a sea change in the healthcare industry as we know it today.

The ecosystem which predominantly includes pharmaceutical companies, medical device manufacturers and healthcare service providers will now begin to include companies which aid well-being. A much larger gamut of industries will be included in the healthcare mosaic, ranging from personal care product companies, technology providers to leisure service providers. From the food individuals eat to the clothes they wear to the activities they participate in are all potentially responsible for their well-being. The healthcare dollar will likely be spread across these industries as well as the growing consumer spending power and eventually reduce the sick-care burden hitting developing and developed countries.

The Information and Communication Technology (ICT) industry in particular will be one of the biggest enablers and benefactors of this transformation in the healthcare industry. The IT revolution has enabled the industry to automate and process information, powered by computer processing cycles, dependable and sophisticated software, and networking capabilities. As we look ahead, it will evolve to helping us sense, analyze and predict information, creating new capabilities in the generation of value.

In Malaysia, like most other countries with similar demographic make-up, there has been a high growth in the number of people with chronic diseases. Prevention and early diagnosis of conditions such as diabetes and cardiac diseases will help reduce the healthcare burden. It is, at present, a country largely dependent on the government for healthcare provision. Over 70 percent of the healthcare requirements are met by the public sector. There is a concerted effort from the government to help shift the balance.

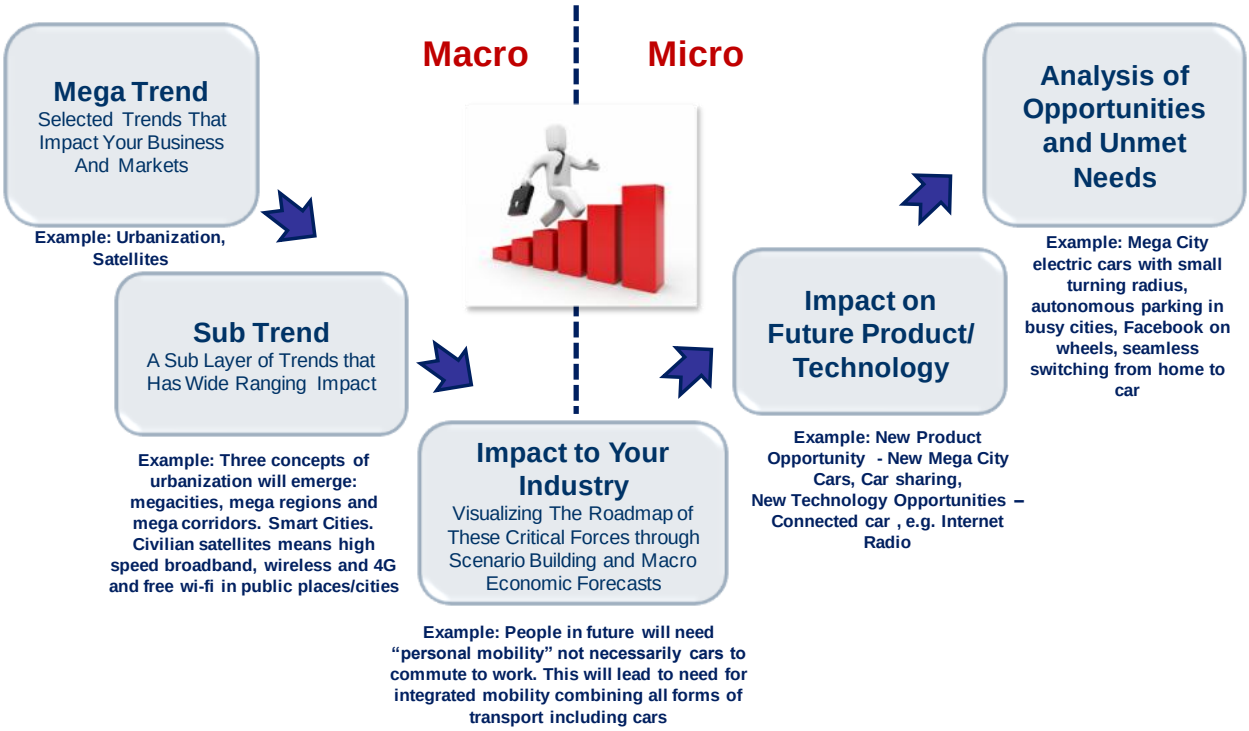
The participation of the private sector in healthcare provision has seen growth in many home-grown organizations with a local and international footprint. Despite being a relatively small market, Malaysia does have completeness in the ecosystem with very well established players across all elements of the new ecosystem that is taking shape. The right policy and regulatory framework can help accelerate the growth of the wellness industry in the country and eventually help them establish themselves as regional and players.

Final Words

What we have realized is that the biggest value of our Mega Trend research was not in any individual Mega Trend. Rather, it was the discussion of all these Mega Trends together that let the imagination fly on the possibilities that exist. The Mega Trends are all connected and inter-wined and therefore synergistic opportunities between them will lead to the creation of several million startups in the coming decade.

We do hope that these insights have trigged some ideas that you will be able to bring back into your business or personal lives. The 12 Mega Trends that were discussed are not exhaustive. We picked a few that we felt would be relevant and are less understood amongst a broader section of the readers. The important part is what comes next.

How do you take these Mega Trend ideas from information to strategy? In Frost & Sullivan, we call this from the "Macro to Micro" approach, which entails taking each Mega Trend, creating scenarios, analyzing impact to your business and designing your future strategy for product and technology planning. Each of these trends have cross-sectoral and synergetic opportunities providing great prospects for all industry stakeholders. In this way, the entire eco system of the Mega Trend will be understood and the most important segment of your value chain will be identified which will redefine your competitive position in the market. We strongly recommend that organizations establish Mega Trend Champions which should ideally constitute of individuals from diverse functional areas.



Frost & Sullivan's Visionary Innovation Research Program conducts ongoing research that cut across a spectrum of exciting Mega Trends such as Mega Cities, Mega Regions, Smart Cities, Generation Y, Geo Socialization, Beyond BRIC: The Next Game Changers, Space Jam, Personal Robots, Virtual Worlds and Haptic Technology, E-Mobility and New Business Models to name a few. The key findings of the Frost & Sullivan report, "World's Top Global Mega Trends to 2020 and Implications to Business, Society and Cultures" covers over 30 mega trends and has already successfully set the stage for visionary thinking for different companies globally.

The F&S Mega Trends program will include regular updates of research reports, growth workshops and customized consulting projects for various companies.

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