

# SHAPING THE FUTURE OF WASTE MANAGEMENT



Some thoughts on future trends and the need to  
establish a forward thinking group

*Antonis Mavropoulos, ISWA STC Chair  
July 2015*

## Contents

SHAPING THE FUTURE OF SWM.....	2
1. Global trends .....	2
2. Trend-spotting.....	5
1. Local activities & global impacts: the case of marine litter .....	6
2. New products – new waste .....	6
3. Market volatility, business models and circular economy .....	6
4. Stocks & the need for final storage .....	7
5. The challenge of governance in a globalized world .....	7
6. Internet of Things.....	7
7. E-Waste.....	8
8. Technologies for everyone .....	9
9. Climate Change – Global coordination .....	9
10. Biotechnology.....	9
3. How to move on? .....	10
Indicative Further Readings.....	10

## SHAPING THE FUTURE OF SWM

The following text aims to open a discussion regarding the future trends of waste management and the role that ISWA can play. It is not a study on future trends, although it includes some major questions that should be answered, in order to outline the future of our world and waste management. It is rather a discussion background that aims to promote a broad discussion within and around ISWA regarding future trends and help the Board, the STC and the WGs to navigate in forward thinking.

We are at a critical juncture in human history, which could lead to widely contrasting futures. This is also true for the future of the waste management industry. In this crossroads, ISWA has to search, discuss and finally imagine what the future of waste management will be for three reasons.

First of all, because ISWA's future depends on its ability to understand and adapt its vision, structure, operations and branding to the new trends. Second, because ISWA would like to be an active contributor for a better future on our planet, so understanding the changing landscape is a major precondition for catalyzing positive changes in our industry. And third, because speaking about the future of waste management creates new audiences and potential partnerships.

It is our contention that the future is not set in stone, but is malleable, the result of an interaction among megatrends, game-changers and, above all, human agency. ISWA's effort is to encourage decision makers—whether in government or outside—to think and plan for the long term so that negative possibilities do not occur and positive ones have a better chance of unfolding. And if ISWA can work like this, then certainly it will upgrade its profile as a global reference point for anyone involved in waste management.

### 1. Global trends

The global framework is shaped by the so-called tectonic shifts between now and 2030, as they are mentioned below in Table 1.

**Table 1: Tectonic shifts between now-2030**

<b>Tectonic shifts between now - 2030</b>	
Growth of the Global Middle Class	Middle classes most everywhere in the developing world are poised to expand substantially in terms of both absolute numbers and the percentage of the population that can claim middle- class status during the next 15-20 years.
Definitive Shift of Economic Power to the East and South	The US, European, and Japanese share of global income is projected to fall from 56 percent today to well under half by 2030. In 2008, China overtook the US as the world's largest saver; by 2020, emerging markets' share of financial assets is projected to almost double.

Unprecedented and Widespread Aging	Whereas in 2012 only Japan and Germany have matured beyond a median age of 45 years, most European countries, South Korea, and Taiwan will have entered the post-mature age category by 2030. Migration will become more globalized as both rich and developing countries suffer from workforce shortages.
Urbanization	Today's roughly 50-percent urban population will climb to nearly 60 percent, or 4.9 billion people, in 2030. Africa will gradually replace Asia as the region with the highest urbanization growth rate. Urban centers are estimated to generate 80 percent of economic growth; the potential exists to apply modern technologies and infrastructure, promoting better use of scarce resources.
Growing Food, Water and Energy Pressures	Demand for food, water, and energy will grow by approximately 35, 40, and 50 percent respectively owing to an increase in the global population and the consumption patterns of an expanding middle class. Climate change will worsen the outlook for the availability of these critical resources. Climate change analysis suggests that the severity of existing weather patterns will intensify, with wet areas getting wetter and dry and arid areas becoming more so.

The tectonic shifts above are realized within the historic framework of the so-called third industrial revolution. We are living in an era of rapid technological growth that generates game-changers like drones, driverless cars, sensors for everything, big data systems, the web of machines and interconnected things etc. There is a growing literature that characterizes our era as the most transformative period of modern history.

Information technology is entering the big data era. Process power and data storage are becoming almost free; networks and the cloud will provide global access and pervasive services; social media and cyber-security will be large new markets. This growth and diffusion will present significant challenges for governments and societies, which must find ways to capture the benefits of new IT technologies while dealing with the new threats that those technologies present. Fear of the growth of an Orwellian surveillance state may lead citizens particularly in the developed world to pressure their governments to restrict or dismantle big data systems.

New manufacturing and automation technologies such as additive manufacturing (3D printing) and robotics have the potential to change work patterns in both the developing and developed worlds. In developed countries these technologies will improve productivity, address labor constraints, and diminish the need for outsourcing, especially if reducing the length of supply chains brings clear benefits. Nevertheless, such technologies could still have a similar effect as outsourcing: they could make more low- and semi-skilled manufacturing workers in developed economies redundant, exacerbating

domestic inequalities. For developing economies, particularly Asian ones, the new technologies will stimulate new manufacturing capabilities and further increase the competitiveness of Asian manufacturers and suppliers.

Breakthroughs, especially for technologies pertaining to the security of vital resources—will be necessary to meet the food, water, and energy needs of the world’s population. Key technologies likely to be at the forefront of maintaining such resources in the next 15-20 years will include genetically modified crops, precision agriculture, water irrigation techniques, solar energy, advanced bio-based fuels, and enhanced oil and natural gas extraction via fracturing. Given the vulnerabilities of developing economies to key resource supplies and prices and the early impacts of climate change, key developing countries may realize substantial rewards in commercializing many next-generation resource technologies first.

New health technologies will continue to extend the average age of populations around the world, by ameliorating debilitating physical and mental conditions and improving overall wellbeing. The greatest gains in healthy longevity are likely to occur in those countries with developing economies as the size of their middle class populations swells. The health-care systems in these countries may be poor today, but by 2030 they will make substantial progress in the longevity potential of their populations; by 2030 many leading centers of innovation in disease management will be in the developing world.

*So a major question is will technological breakthroughs be developed in time to boost economic productivity and solve the problems caused by a growing world population, rapid urbanization, and climate change?*

The answer to this question depends a lot on (global, national and local) governance patterns and their evolution. During the next 15-20 years, as power becomes even more diffuse than today, a growing number of diverse state and non-state actors, as well as subnational actors, such as cities, will play important governance roles. The increasing number of players needed to solve major transnational challenges—and their discordant values—will complicate decision-making. Prospects for achieving progress on global issues will vary across issues. The governance gap will continue to be most pronounced at the domestic level and driven by rapid political and social changes. The advances during the past couple decades in health, education, and income—which are expected to continue, if not accelerated in some cases—will drive new governance structures.

The widespread use of new communications technologies will become a double-edged sword for governance. On the one hand, social networking will enable citizens to coalesce and challenge governments. On the other hand, such technologies will provide governments an unprecedented ability to monitor their citizens. It is unclear how the balance will be struck between greater IT-enabled individuals and networks and traditional political structures.

The current, largely Western dominance of global structures such as the UN Security Council, World Bank, and IMF probably will have been transformed by 2030 to be more in line with the changing hierarchy of new economic players. Many second-tier emerging powers will be making their mark—at least as emerging regional leaders.

*So another major question is will governments and institutions be able to adapt fast enough to utilize the change instead of being overwhelmed by it?*

In this continuous and sometimes rapidly changing landscape, ISWA has to outline the key-trends for the future of waste management.

## 2. Trend-spotting

Although it is very difficult to identify future trends with a relative certainty (as Niels Bohr put it “prediction is very difficult especially about the future”), there are certain ways that are helpful in order to outline the key-trends.

First of all, the future of waste management should be studied in the context of the future trends of our world. Waste management is an integral part of our day to day life and the major shifts that affect people’s daily lives, in one or another way, affect behaviors, technologies, logistics and finally waste management arrangements too.

Listening to industry experts is a certain way to understand some future trends, especially the ones that are more close to industrial innovation activities. Industry experts are familiar with the major problems that they face to their day-to-day activities and they create the conceptual basis for the future improvements required, although this is usually done through continuous optimization procedures rather than radical shifts.

Studying the evolution of research topics and activities, talking with researchers and following the most important scientific publications is another key-element to identify issues related to the future of waste management. A sensitive and careful analysis of the major research priorities and trends creates a good picture of “what’s next”.

*It is worthy to mention that ISWA has the network, the know-how resources and the means required to spot future trends by both researchers and industry experts, so it is just a matter of appropriate structures and purposeful activities to utilize the resources available.*

Based on several papers and experiences gained in cooperation with universities, research centers and industry experts, the following list presents some of the most important trends for the future of waste management. It is mentioned that Circular Economy is not included in this list because it is

considered more as a background concept that influences all the current trends and less as a trend itself – in addition, ISWA’s TF on Resource Management has done already an important work towards the understanding of circular economy and its implications to our industry.

### **1. Local activities & global impacts: the case of marine litter**

Marine litter will be a key-issue for waste management for the next 2-3 decades. Together with climate change, marine litter and ocean garbage gyres prove that no matter if we understand it or no, local waste management practices create global impacts and that there is a need for global coordination in order to manage such global impacts. Marine litter is also a certain signal for the limits of our societies, the technological, social and ecological ones. Marine litter is straight forward associated with ecosystem’s damages by plastic pollution, tangible and measurable impacts and it represents a huge global and local challenge for the international stakeholders, the governments and the industry. The solutions required have just started to be discussed publicly and some pilots have started to be tested. For sure, the solutions required will need changes in the whole life cycle of plastic products and not just in the way they are managed when they are considered as “waste”. At the same time, marine litter impacts (much more than climate change) are easily understood and visualized, so it will be a powerful communication “bridge” too, for broad audiences.

### **2. New products – new waste**

We are living in the beginning of the third industrial revolution, where a huge improvement in resource productivity has already started to happen. As in all industrial revolutions, a tsunami of new products will replace old ones and the term “waste” will be redefined on both the industrial and the domestic scale. Many new products are rapidly produced and circulated worldwide and their consumption will create new challenges for our industry. Spent photovoltaics, gadgets, mobile phones, wearables, nanomaterials, new composite packaging materials and complex biomaterials are just some examples of what the industry has to manage already, without adequate know-how and established practices. The shift to circular economy will certainly provide some solutions, sooner or later, but we can’t expect that this will be the prevailing paradigm in the near future, despite the efforts made.

### **3. Market volatility, business models and circular economy**

There is a growing attention to the importance of appropriate business models that will make technical solutions economically viable and financially affordable. This growing attention is built on two pillars. The first pillar is the recycling market failures that are periodically repeated in different parts of the world, either due to local - regional economic crisis conditions or due to global market volatility. The second pillar is the emergence of new business models that stimulate circular economy approaches, like sharing practices, replacing ownership with service models etc. Both pillars demonstrate the importance of well-designed and adaptable business models for the long-term viability of successful waste management and recycling systems. At the same time, there is a

growing emphasis for high value for money ratios and functional but still low cost solutions especially in the developing world.

#### **4. Stocks & the need for final storage**

Urban mining science and practices will be further developed as long as older cities' infrastructures are getting outdated and resource scarcity will be more intense, for specific vital resources. Urban mining will be also stimulated by the circular economy concepts. Landfill mining is getting again into research activities, after almost a decade of limited or even negligible presence, even in EU. The speed of urban mining applications will be determined by market prices and their volatility but also by technological advances that will allow the separation of clean materials with low cost. Construction and demolition waste, tyres, lead pipes, rubber, cables and old electronics will be some of the key-targets and appropriate business models will be developed to allow recovery and reuse of them, with suitable monetization patterns. The more the development of urban mining, the more the need for final storage solutions will be, as the limits to recycling and recovery will be more intense and obvious for outdated infrastructure.

#### **5. The challenge of governance in a globalized world**

According UN, SWM and recycling is a key-indicator that demonstrates the good governance of a city or a region. The new global landscape provides new challenges for waste management that have not been studied and discussed yet. The growing interconnectivity both supports further globalization and flow of cultures, ideas and trends and at the same time it results in serious impacts to waste management governance patterns. First, globalization makes it increasingly difficult for states to rely only on national regulation about waste management in order to ensure the wellbeing of their citizens and their environment. Second, there is a growing demand and need for global initiatives and regulations, especially the means to enforce existing agreements and build upon their authority to improve environmental performance. Third, globalization facilitates the involvement of a growing diversity of participants and their coalitions in addressing waste management issues, including other governments and international organizations, global market players and local-global civil society actors. Fourth, the direct increase of international financial flows dedicated to waste management creates a new arena for local decision-making, especially for the countries that are receivers of grants, FDI and loans.

#### **6. Internet of Things**

The convergence of the current web with the emerging web of sensors (already more than 13 billion sensors are on-line worldwide and they are expected to be more than 30 billion in 2020) and the growing web of small energy generators will create new unprecedented opportunities and threats. The deluge of data generated by transactions, medical and legal records, videos, social media, sensors, cameras, bar codes and transmitters embedded in the world around us has an enormous economic and technology potential. There is a fundamental change underway in how the world solves problems like poverty, gender based



violence and environmental degradation. In the past, these problems were mostly left to national governments and international bureaucracies. Today, there are hundreds or maybe thousands emerging “global solution networks” where self-selecting networks of individuals and organizations convene across sectors to advance their own solutions. In many cases, these emerging solutions are more agile, innovative and effective than the traditional state-based institutions. In the new, networked model of problem solving, technology provides the enabling platform on which diverse participants come together to develop and implement solutions to global problems. Technology not only fosters low-cost connectivity across borders but also provides a richer palette of data, tools and techniques with which to transform the way we solve global challenges. The proliferation of RFID, satellite imagery, cheap personal video recorders, smartphones, and a global grid of wireless sensors have driven quantum leaps in the amount of Internet-collected data available to scientists and policy makers. Besides all, the development of low cost and high connectivity sensors is expected to transform the design, construction and operation of all kind of facilities and it is expected that sanitary landfills will also benefit a lot from that.

## 7. E-Waste

According the most recent statistics by STEP (Solving The E-waste Problem) initiative (<http://www.step-initiative.org/overview-world.html>), in 2014 roughly 42 million tones of E-waste were generated. The global production of E-waste is continuously rising and it will be exponentially increased as developing economies grow and new technologies are developed. For any given country, the total number of computers and other potential E-waste items is strongly correlated with the country's GDP, because electrical and electronic items are essential for the functioning of all but the most primitive economies. But the main problem is not their rising generation but their inappropriate management and the associated illegal exports - recycling and dumping practices, mainly at India, SE Asia and China. Despite the many international efforts to resolve the problem, E-waste management is becoming an emblematic failure of our modern societies as it combines a. rapid and continuous technological progress in manufacturing and process power b. fast consumption and rapid change of products or their versions and c. an unprepared waste management system which finally pushes e-waste to SE Asia for environmentally harmful management. Contamination associated with E-waste has already caused considerable environmental degradation in poor countries and negatively affected the health of the people who live there. The rapidly growing literature and evidence on the serious environmental and health impacts posed by current management practices in China and India is a certain signal for the importance of the problem. E-waste should be considered as a global health emergency too. There is limited knowledge on the ecological effects, human health risks and remediation options for some E-waste contaminants, such as Li and Sb, since they are not normally environmental pollutants. Rich countries have self-interest in mitigating the negative environmental effects of E-waste because it will

negatively affect the quality and quantity of food and manufactured goods that are imported from poor countries.

### **8. Technologies for everyone**

There is a new wave of small-scale commercial products. Those products have been designed and commercialized either to cover the needs for decentralized solutions or as a result of the technology progress that allows viable waste management solutions even on a neighborhood or household level. Organic waste driers, as small as 1-100 kg/day, are already commercial and tested in thousands of households, hotels and restaurants, producing a dry organic fraction with 70-80% weight reduction (obviously very convenient if the user is charged by weight). Small-scale community anaerobic digesters for food waste, with a batch reactor of 1-10 m<sup>3</sup>, are already tested in UK neighborhoods. Small modular waste to energy plants (from 10-30 tons/day) are already commercial by German companies, with very competitive prices. Well, this is a new world of products and it is possible that many more similar products will appear in the near future, as the manufacturing technology progresses with fast pace.

### **9. Climate Change – Global coordination**

Climate change will continue to be a major trend that will shape waste management activities and priorities, on a global and regional level. As ISWA is already involved in similar activities and several important documents are already available, there is no need to specify more things about it, in this particular note.

### **10. Biotechnology**

There is a whole new world of products and applications related to biotechnology and certainly, they would affect in one or another way the current waste management practices. It is not only about biodegradable bags, biodegradable waste management and biodegradation - bioremediation processes that are already applied in many cases – biotechnology goes much further and it can be an important contributor towards the effort to meet the rapidly growing demand for energy, food, nutrition, and health. According to the world's leading experts, there are ten specific promising technologies that can reshape the industry and as it is obvious, some of them will have serious impacts to waste management industry too. It is important to notice that one of those promising technologies is called “Non-resource draining zero waste bio-processing”. The technology concerns the achievement of the zero waste goal through biotechnology. Waste streams can be processed at bio-refineries and turned into valuable chemicals and fuels, thereby closing the loop of production with minimum or even zero (in the long-term) net waste. Advances in biotechnology are now allowing lower cost, less draining inputs to be used, including methane, and waste heat. These advances are simplifying waste streams with the potential to reduce toxicity as well as support their use in other processes, moving society progressively closer to the sustainable goal of zero waste. There are already facilities that produce bioethanol from mixed waste and it seems that there are several coordinated efforts towards this direction.

### 3. How to move on?

As it has been already noticed this text aims to open a discussion regarding the future trends of waste management and the role that ISWA can play. It is a discussion note that should be used carefully in order to be helpful. So, the next steps are proposed in order to have a fruitful discussion.

- An early version of this note will be discussed at the 2015 General Pre-Assembly, as decided recently by the Board.
- Discussion at the STC on September 2015 - this discussion should improve and/ or change this note and then identify more specific priorities and / or projects for ISWA's entities. The paper will be modified after the STC discussion and in its final version will be circulated to all WGs, in order to be taken into consideration for their future programs. The STC should propose the establishment of an ad-hoc forward thinking group. This will be a group that will manage the dialogue on future trends within ISWA
- The Board will discuss the modified paper also – after Board's improvements and modifications it should be circulated to all national members. Based on STC's suggestions, the Board should establish a forward thinking group that will manage the whole process.
- RDNs and Young Professionals Group will also discuss this paper and provide their own feedback.
- Finally, all the feedback will be processed and used in order to prepare a report to be presented for 2016 conference – a relevant session should also be organized at 2016 conference to present the outputs of the dialogue. The aim is to adopt some recommendations for future ISWA activities and focus from 2016 onwards.

### Indicative Further Readings

- "Global Trends 2030 – Citizens in an Interconnected and Polycentric World", European Strategy and Policy Analysis System, 2013
- "The Digital World in 2030 - What place for Europe?" , European Internet Forum, 2014
- "Global Trends 2030, Alternative Worlds", National Intelligence Council, USA, 2012
- "The world in 2050", HSBC Global Research, 2012
- "2030: The perfect storm scenario", Population Institute
- "The world agriculture towards 2030-3050", FAO, 2013
- "The world in 2050 – will the shift of global economic power continue?", PWC, 2015