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The Management of Natural Resources: An Overview and Research Agenda

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FROM THE EDITORS

THE MANAGEMENT OF NATURAL RESOURCES: AN OVERVIEW AND RESEARCH AGENDA

Editor's note: This editorial is part of a series written by editors and co-authored with a senior executive, thought leader, or scholar from a different field to explore new content areas and grand challenges with the goal of expanding the scope, interestingness, and relevance of the work presented in the Academy of Management Journal. The principle is to use the editorial notes as "stage setters" to open up fresh new areas of inquiry for management research. GG

Natural resources underpin the foundation of human activity. Individuals and organizations consume vast amounts of natural resources as a matter of routine without much cognizance of their continued availability in the future or the true cost of a depleting natural resource. Over the past decades of industrial activity, organizations, communities, and nations have acted to protect their interests by investing in and securing their supplies of natural resources that support economic growth. An industrial complex, now variously termed as extractive industries, supplies crucial non-renewable natural resources such as oil and coal for energy or iron and aluminum for construction. Our societal reliance on the consumption of natural resources grows unabated such that the discussion of sustainability of natural resources has taken primacy in policy and executive concerns. However, scholarly research on understanding the management and the organization of natural resources remains limited, especially regarding its industrial ecosystem of use and trade and its implications for individual behavior, organizational performance, and quality of life.

Since the 2008 *food* crisis, food supply uncertainty has driven up competition for land between countries, food and energy crops growers, and speculative financial investors (Smaller & Mann, 2009), which in turn has affected prices, local availability, and the livelihoods of many. The relative scarcity of potable *water*, in combination with the dramatic effect of local shortages on agriculture and livelihood, has put water risks and opportunities amongst the top sustainability issues (Ernst & Young, 2012;McNally, 2015; PWC, 2011). According to the United Nations (2012), 783 Million people do not have proper access to drinking water, and in sub-Saharan Africa,

water is unavailable to over 40% of the population. More than 850 Million people are undernourished and at risk of starvation, and over 1.1 Billion do not have access to energy, which necessitates innovative business models for off-grid rural areas (Schillebeeckx et al., 2012). In a study of Indian slum settlements, Parikh and colleagues (2015) find that the provision of water services increased education by 62% and income by 36% by freeing up the time women spent on fetching drinking water, pointing to the link between basic resources availability, social development and the labor market. Access to water and energy has the effect of shifting individual aspirations upwards to health, education, and land ownership (Parikh, Chaturvedi & George, 2012). However, the industrialization and growth in world economies is yet to provide equal access to basic natural resources such as food and water for sustenance. Food, water, and energy remain basic natural resources that face scarcity and disproportionate access inequality.

With *energy minerals*, recent reductions in the oil price are causing havoc to investments in the natural gas and shale gas markets. The Carbon Tracker's study on stranded assets convinced the largest sovereign wealth fund in the world to set up an expert panel which initiated a significant divestiture of coal assets and eventually an outright ban on new coal investments (Carrington, 2015). Additionally, various *non-energy minerals and metals* are facing increasing constraints. Lithium price increases driven by the electrical vehicle industry's demand for lithium-ion batteries risk pricing other lithium-using industries (e.g. electronics, ceramics, glass, lubricating greases, nuclear technology, and in various medicines) out of the market and in search for substitutes.

Ernst & Young's (2013) report on growing trends in sustainability points to the "increased risk and proximity of natural resource shortages" (p. 21) so that assessing the availability and reliability of strategic business materials and developing risk management plans to address supply disruption contingencies become strategic imperatives. These recent evolutions in the natural

resource debate and the presence of scarcity-related issues across a wide variety of renewable and non-renewable resources, across local and global challenges, across small, medium, and large enterprises, and across resource-rich and resource-constrained countries, evidence a clear need for management scholars to engage and support this debate with systematic evidence.

AMJ editorials on climate change as well as risk and resilience highlight the growing importance of organizational action to address large scale, seemingly intractable, societal grand challenges (Howard-Grenville et al., 2014; van der Vegt et al., 2015). In this editorial, we review past work in *AMJ* and, not unexpectedly, find that while we have made expansive use of the term "resources", specifically when it pertains to employee resources and human assets, the focus on natural resources has lagged significantly behind. We provide a simplified overview of work in *AMJ* over the past fifty years on the broader use of resources, and focus instead on themes identified in natural resources as a context.

Our intent is to inspire management scholars to take up the Grand Challenge to provide strategic and managerial insights in conversations and debates that have so far been held by policy-makers, economists, natural scientists, and engineers. As organizations' objectives can diverge from those of governments, citizens, and stakeholders, the interplay between corporate decisions, institutional and regulatory actions, societal pressures, and important externalities of extractive processes, provides an exciting context for theoretical and empirical research. We provide examples of how natural resource scarcity is challenging businesses, governments, and industries at large to innovative technologies and business models, compete in natural resource markets, and collaborate across industrial, national, and cultural boundaries.

"RESOURCES" IN AMJ

As the flagship empirical journal of the Academy of Management, *AMJ* has a strong impact on what is being studied in the field of management at both macro and micro level. Therefore, the journal not only inspires research across a wide range of other journals but also reflects the high-level and theoretical conversations that are being held in those journals (Joshi et al., 2015). EBSCO hosts 3,456 articles published in *AMJ* between 1963 and 2015[1]. Within this population, we find 319 that have resource* either in title, abstract, author-supplied keywords, or subject terms. Those 319 articles were analyzed to reveal broader patterns of discussions on resources. Of all selected articles, only one article mentioned "natural resources" as a keyword. For comparison "information resources" were mentioned 57 times, resource allocation 58 times, resource management 53 times, resource-based theory 21 times, and resource-dependence theory thrice. Also, studies focusing on human resources – with keywords like personnel management, human capital, employee attitudes, selection, recruitment, or training, job satisfaction or performance labor turnover or productivity - occurred more than 200 times.

Prior attempts to categorize resources have distinguished between human, financial, physical, technological, organizational, and reputational resources (Grant, 1999). Others have provided a typology for intangible resources differentiating between human, organizational, technological, and relational capital (Fernández et al., 2000). What is common across studies is that most resource typologies have been inspired by resource-based theory and have focused on resources that exist within organizational boundaries, with some extensions to relational resources (Dyer & Singh, 1998). Within institutional theory, Rojas (2010) differentiates between symbolic,

[1] Numbers correct on October 5, 2015

coercive, and normative resources. Table 1 provides an overview of a selection of exemplary articles that capture a specific way in which resources have been conceptualized in AMJ.

----------Insert Table 1 about here ----------

The overview suggests that *AMJ* articles that mention the term resources fall under three broad categories: (1) *people as resources* including the human resource, human capital, and social capital perspectives, (2) *organizational assets as resources* that frame resources as a state (slack or distribution), type (specific capabilities or assets), and action (bundling or deploying), and (3) *inter-organizational and societal resources* that address jointly produced or controlled resources that lie outside the focal firm or within or across firms and communities.

What becomes clear is a striking lack of attention to natural resource issues. Bode et al. (2011) focus on supply chain disruption in manufacturing but their survey does not investigate whether natural resource availability caused disruptions. Powell and Baker (2014) investigate how resource-constrained founders respond differently to adversity and, while acknowledging the relevance of exogenous material constraints, focus on differences in founder identity. Boone and Ozcan (2014) investigate the emergence of cooperatives in the US bio-ethanol industry. In general, when natural resources are mentioned they are a constitutive part of the context in which another phenomenon is being studied.

Natural Resources in AMJ

Given the absence of natural resource-related articles in the original sample, we looked for articles using various 'natural resource-related' keywords[2]. This resulted in 264 articles. Because we needed to look broadly for keywords that refer to natural resources in our second sample, the

[2] "natural resourc*" OR wind OR oil OR gas OR solar OR steel OR energ* OR renewable OR "natural environment" OR nature OR water OR forest OR diamond* OR coal OR "material" OR input* OR throughput* OR metal OR land OR agricultur* OR food

a significant number of the found articles were irrelevant, as they used the keywords in a different context (e.g. "materials" from the sociological literature, the "nature" of research / business / the problem, data as "inputs" for use / input-output model of behavior / labor inputs). As such, of the 264 originally selected articles, 175 were dismissed because they were included based on a different meaning of one of the search terms, leaving 89 articles that potentially provided insight into how natural resources have featured in AMJ.

These 89 articles can be split into two groups. The majority mentioned a specific natural resource as a context in which unrelated questions were studied. Hence the natural resource in question was not a focal part of the study and is seen as incidental to the management theory being tested. The lion share of these studies focused on individual roles and effects, which is consistent with our previous findings regarding the attention to human resources. Given the similarity with the Table 1, we provide representative examples studies in the *Individuals roles and effects* row of Table 2. The following two rows focus on *Individual attitudes towards the environment* and on *Organizational attitudes and performance outcomes*.

---------- Insert table 2 about here ----------

Besides the areas of research exemplified in the tables above, a few other subdomains emerged from the literature review, with significant attention to regulatory and institutional perspectives. Studying the origins of regulation with regards to GMOs, Hiatt and Sangchan (2013) find that regulators are influenced by assessments of powerful stakeholders and peer agencies about the issues at hand. More attention was paid to organizations' responses to regulations. In the nuclear energy sector, Marcus (1988) found that organizations with poor safety records responded in a rule-based manner while those with stronger safety records responded more autonomously, thus hardly improving general safety. Studying the organic food industry, Lee (2009) investigates

the relationship between local and federated standards-based certification organizations and changes in US state laws, and finds that local structures enhance legal innovation and elaboration but reduce variation, while the opposite holds for federated structures. Madsen (2009), perhaps counterintuitively, found that more stringent regulation need not result in less corporate investment in the regulated region. Additionally, environmental policy, in combination with management support, positively influences employee eco-initiatives (Ramus & Steger, 2000). Some regulatory externalities were also presented: Utilities heavily reliant on nuclear energy provide leadership and this leadership negatively relates to public safety (Osborn & Jackson, 1988). Furthermore, pollution regulation erects barriers to entry (Dean & Brown, 1995).

At the institutional level, Hoffman (1999) found that organizational fields can form around issues such as environmental impact in the chemical industry. Maguire and Hardy (2009) studied the eradication of DDT (chemical) usage to reveal institutionalized practices abandoned through defensive institutional work, and that field-configuring events, via the mechanisms of new discourses, can change institutional fields (Hardy & Maguire, 2010). Building on that work, Schussler et al. (2014) looked at UN climate conferences and showed that variations in field-configuring events' structures, processes, and outcomes can explain the failure to bring about institutional change.

The takeaways from this synoptic overview of (natural) resources are threefold. First, theoretical diversity has allowed 'resources' to be conceptualized and operationalized in distinct ways but this multiplicity has created an all-encompassing category in which everything is and can be a resource. Second, despite this broad categorization, management scholars have paid only scant attention to physical and natural resources and their idiosyncratic characteristics; this in direct opposition to human, relational, and knowledge resources. Third, in the last two decades attention

to corporate social / environmental responsibility and to regulatory and institutional aspects of the natural environment has risen, but this increasing attention has not been accompanied by a stronger focus on natural resource inputs or throughputs in production and social processes.

WHAT MAKES RESOURCES SCARCE?

Resource scarcity has been on the agenda of economists, politicians, and environmentalists for centuries. Over the years, the meaning of scarcity has been subject to considerable modification. Malthus (1798) feared agricultural land would be incapable of providing enough food for an ever-growing population, while Ricardo (1817) stated that scarcity was a function of different grades of ore quality. This implied a transition from *biophysics* to *technology* as the focal constraint on resource availability. Hotelling (1931) conceived of an "economics of exhaustible resources" and concluded that scarcity is transparent in resource prices hence providing a market rationale for scarcity. The rapid growth of the post-war economy sparked doubts as to whether market prices were suitable mechanisms to avoid resource exhaustion. Tober (1974, in Brown and Field, 1978) for instance submitted that prices of wild pigeons remained stable until their complete extinction in 1890. Much later, social psychologists concluded that humans have a strong tendency to overconsume physical, spatial, and temporal resources (Herlocker et al., 1997), with the Easter Island as the prototypical example. The seminal "The Limits to Growth" foresaw economic collapse due to food and mineral shortages (Meadows et al., 1972), thus echoing Malthus, while the thirty year update brought more pessimism due to squandered opportunities and highlighted the impact of exploitation on natural ecosystems (Meadows et al., 2004).

The last two decades have chiefly focused on these ecosystem implications with climate change and global warming becoming part of our daily vocabulary. The current discourses on planetary boundaries (Rockström et al., 2009), resource security (Buijs & Sievers, 2012; Defra,

2011a), and the resource nexus (Workman et al., 2016) are the latest evolutions on the topic of scarcity. What these modern interpretations of scarcity show is that the geochemical or biophysical availability of natural resources is *not* the focal constraint on resources' availability. Given the plurality of scarcity drivers and the associated uncertainty, it becomes crucial for governments, organizations, and individuals to respond to such causally ambiguous exogenous resource constraints.

Thus far, the management field has mainly used a singular frame to address scarcity – the resource-based view, which defines resources rareness as imperfect market competition (Barney, 1991). Imperfect competition affects many natural resources as they are subject to e.g. regulation, risk of government appropriation, large capital requirements, immovable production factors, information asymmetry, and increasing returns to scale. Also, prices are often set in private negotiations (many scarce minerals), or in other cases are heavily subsidized (water, agricultural land) and thus markets cannot function efficiently. As long as we are agnostic about the determinants of scarcity, our understanding of phenomena that are influenced by imperfect markets remains limited.

Many metals are used in relatively small quantities in various markets (Table 3) but their unique properties make substitution difficult, so that price volatility or shortages lead to severe supply chain disruptions. The rare earth market for instance, dominated by Chinese production, has been associated with lawsuits in front of the WTO tribunal (Hook, Chaffin, & Beattie, 2012). When China reduced its export quota prices surged by up to 850% in the second half of 2010 (Humphries, 2012). More generally, various financial market specialists argue that we have reached a paradigm shift: the 100 years of ever-cheaper commodity resources are permanently

over, and that increasing competition and rising prices for ever-scarcer resources will become the new norm (Grantham, 2012).

---------- Insert table 3 about here ----------

MANAGERIAL IMPLICATIONS OF NATURAL RESOURCE SCARCITY

As a field, we have worked under the assumption that the tangible (natural) objects that are being managed are much less important than the intangible aspects that characterize the nature of management itself. In light of recent events in natural resource markets, this assumption appears deeply flawed. Specifically, the World Economic Forum (2008) reported that supply chain disruptions, food security, energy security, and systemic financial risks are the four most important emerging issues. The first three are intrinsically connected to natural resources, and they impose grand managerial challenges. In this section, we highlight several areas as potential for scholarly dialog and empirical research.

Organizational Responses to Scarcity

Natural resource scarcity potentially affects organizations in multiple ways. Schoolderman and Mathlene (2011) found that global manufacturing executives increasingly worry about natural resource scarcity and that new business models and supply chain innovations "will be fundamental to the ability to respond appropriately to the risks and opportunities posed by scarcity of minerals and metals" (p. 5). Relatedly, an executive survey of the UK manufacturers' organization put raw material shortages as the most critical challenge for the companies' survival (EEF, 2012). Hence, not surprisingly, we witness multiple corporate actions to ensure stable natural resource supply.

Toyota invested in two collaborative projects, one with Indian Rare Earth in Orissa and another with Vinacomin (Vietnam) and Sojitz (Japan). A diverse group of German companies such as BMW, Daimler, Bosch, BASF, and Bayer have formed an alliance to secure key raw materials

in the face of mounting competition from emerging economies. Land acquisitions by big multinationals in Africa and Asia risk exacerbating malnourishment in local population as these 'land grabs' often take place in countries where hunger is societal problem (Rulli & D'Odorico, 2014). This is accompanied by increasing state-based foreign investment in foreign lands with a view to a lock in access to water for agriculture (Smaller & Mann, 2009).

Scarcity also inspires business model and design innovations such as longer-lasting products, modularization and remanufacturing, component re-use and designing services with less material (Allwood et al., 2011). General Electric is working with the US Department of Energy to find ways to make permanent magnets (fundamental to wind energy) using nanotechnology in order to reduce rare earths needs by 80% (Ernst & Young, 2011). Tesla set up a recycling scheme with metal-recycler Umicore to ensure a proper end-of-life treatment of the Panasonic/Tesla batteries. By investing in this urban mining partnership, Tesla increases supply of natural resources in the long run. In general, urban mining offers the promise of higher yields and lower externalities than many virgin mining operations but it requires smart initial design for it to be economically viable. Ford took a different road and switched to lithium-ion batteries for its Fusion and C-Max models, thereby reducing the need for dysprosium, the most expensive rare earth metal. Unilever has taken up the challenge of frugal innovation, with an ambitious goal of doubling its revenues by 2020 while reducing its environmental impact by 50%. Key in achieving this will be to successfully reinvent soaps and detergents so that they use less water.

Entrepreneurial ventures can alleviate concerns of resource availability. Innovation Metals Corporation's business model increases market efficiency through the establishment of a rare earth exchange where scarce metals can be traded as commodities, and through the development of a platform based on a centralized multi-purpose refinery. Following the formation of the Impact

Investment Exchange Asia, and Impact Partners, a direct investment platform, Shujog was created as a non-profit whose objective is to assess impact and quantify it so that organizations can measure and magnify it.

More generally, "ecopreneurship" and social entrepreneurship are on the rise. Consider the story PlanToys, a Thai company that reasoned back in 1981 that decommissioned rubber trees could be used to make toys rather than to be burnt. Besides starting a successful business, their idea created an end-of-life market for these latex-producing trees, thereby supporting local farmers' livelihood. In another example, the Dutch Embassy in Bangkok is launching a social enterprise incubator for entrepreneurial students and young starters from the ASEAN region and the Netherlands. The first iteration of the project will start in January 2016 and aims to tackle local waste problems. UK-based start-up Provenance combines state-of-the-art blockchain technology Ethereum with an ambition to track the origins of materials securely and anonymously so that companies do not have to disclose their entire value chain. By tracking the origin of materials, Provenance intends to make working conditions and environmental externalities associated with natural resource extraction transparent.

In the management literature, the importance of the environment as a constraining factor on firm behavior has been stressed in various organizational theories such as institutional theory, resource dependence theory and population ecology. Firms generally seek munificent environments and attempt to enhance the munificence of their present environments, by increasing political, economic, technological, structural, and social forms of capital. The last few years have exhibited a great variety of managerial practices and strategies to respond to scarcity-induced environmental challenges. These emerging strategies warrant the extension of existing theories and perhaps the introduction of a new theory that explicitly addresses tangible (natural) resources.

Institutional Responses: Government Intervention

Policy makers have expressed growing concerns about the influence of resource availability on their country's growth and local companies' ability to compete in global markets[3]. Governments' primary function in the market is to establish and enforce the rules of the game. Defra's waste policy (2011b) and the European Waste Electrical and Electronic Equipment (WEEE) directive are examples of how governments attempt to shape industrial practices by enforcing standards on recycling. The European Restriction on Hazardous Substances (RoHS) and the Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) are exemplars of how governments steer industry behavior by enforcing limits on the free use of materials that have negative impact on human wellbeing. The US Rare Earths Supply-Chain Technology and Resources Transformation Act of 2010 is oriented towards re-establishing a competitive domestic industry for rare earth production so that the US government is supporting a revival of an extinct industry. Such policy texts are essential parts of institutional discourses that justify intervention. How these discourses influence corporate discourses (and vice versa) on these issues is an interesting avenue for future research.

When governments lack resources, they cannot make the rules nor create an incentive structure for companies to behave appropriately. In these situations countries are taking action in the World Trade Organization (WTO) to enforce free markets and competitive pricing. The WTO upheld a ruling that China's policy with regards to raw materials exports violates international trade rules, which inspired the US, Japan, and the EU, to officially challenge China's rare earth policy (Hook et al., 2012). Prices for select rare earth oxides are significantly cheaper within China

[3] The United Kingdom's Department for Energy, Food and Rural Affairs (2011b), the European Commission (2010, 2011), the US National Research Council (2008) and the US Department of Energy (2011) to name only a few key players.

than elsewhere, and the difference exceeds the export taxes imposed by the Chinese government. Such price differences are an example of how the Chinese government uses its market dominance. While there is a case to be made that lower local prices can be justified as producing countries absorb negative mining externalities, those in need of resource access have generally downplayed the value of such arguments (Hayes-Labruto et al., 2013).

Besides making and enforcing rules, governments are establishing partnerships with resource-rich countries and are sharing technology and knowledge in exchange for access to scarce resources. Japan exchanged nuclear technology with Vietnam, the country with the fifth-largest rare earth deposits and signed partnerships with Kazakhstan and India for the joint development of rare earth mines, making promises about cooperation on nuclear technology in return (Miyazaki, 2012). Germany built partnerships with former Soviet countries such as Russia, Mongolia and Kazakhstan to develop mines and South-Korea forged agreements with resource-rich nations, often through direct involvement of government entities (Ernst & Young, 2011; Vateva, 2012). Such countertrade has not been studied extensively in the last decade. When governments take such direct action in the market, what are the effects on competition? On the one hand, government actions could level the playing field for resource-dependent companies ensuring equal access to required inputs. On the other hand, they risk alienating innovators that are developing alternative products or services that do not require the same natural resource inputs. Thus, empirical evidence is needed to show whether government involvement merely postpones the inevitable decline of specific sectors or if it can indeed help overcome supply uncertainty and stabilize markets.

In addition to technology exchange, governments set up platforms for collaboration within and across their countries' boundaries. The German Government established the Centre for Resource Efficiency in cooperation with VDI, the German association of engineers and set up a

Resource Efficiency Network (BMWi, 2010). The Interreg-supported Cradle to Cradle Network brings together governmental agencies and industry specialists from Netherlands, Flanders, Slovenia, Bulgaria, and Italy. The project aims to spread best practices around cradle to cradle design (McDonough & Braungart, 2002) across its members and supports a variety of research implementation projects.

Finally, governments aim to decrease uncertainty in their regional markets by facilitating the development of new (or old) mines. In the midst of the rare earth crisis, the US government actively supported the reopening of the Mountain Pass mine with special environmental permits. Molycorp invested nearly 1 Billion USD in rejuvenating equipment and making the mining process more environment-friendly. This was hailed as being a heroic move of an American corporation, vital for national security (Martin, 2011). Yet only a few years later, the company filed for Chapter 11 bankruptcy, costing investors all over the country a massive financial hangover while the national security discourse had completely disappeared (Heffernan, 2015). The German Government's Raw Materials Strategy details the financial support available to companies through a variety of mechanisms (BMWi, 2010). The Institute for Geosciences and Natural Resources surveys potentially rich raw material zones for the benefit of German businesses and supports exploration efforts. Japan is looking into sub-ocean mining, increasing recycling capacities and stockpiling used electronic equipment while South-Korea has devised a stock-piling strategy to avoid shortages (Ernst & Young, 2011). In summary, governments all over the world are taking action to deal with and prevent natural resource shortages and supply instability. Different measures are being taken and more often than not, governments are directly inserting themselves in (imperfect) market processes. An increased attention to natural resource scarcity and material efficiency is evident, presenting organizational scholars a rich context to contribute evidence.

From blood diamonds to fresh water: Social impacts of natural resources

It has been argued that persistent natural resource scarcity is associated with increases in material inequality, the intensification of international and national conflicts, and institutional shifts towards more closed and authoritarian regimes (Gurr, 1985). For society at large, resource extraction externalities such as pollution and soil toxification, shortages of essential resources, and the possible consequences associated with externalities and shortages such as unrest, conflict, war, hunger, drought, and mass migration pose grand challenges. These challenges not only affect governments and organizations but also individuals that work in affected environments, face shortages, or risk falling victim to war or becoming refugees.

In this light, individual citizens and employees can be gravely affected by scarcity-related problems. In a study of 144 countries between 1985 and 2007, Apodaca (2012) finds that scarcity indicators such as the cereal yield, the presence of water resources, and forest depletion, give rise to anti-government demonstrations, strikes, and riots and that the latter are also associated with increases in human rights violations that threaten the physical integrity of the person. Therefore, citizens that live in territories where scarcity is prevalent are not only at risk because of scarcity of fundamental resources like food, water, and clean air, but also face a higher likelihood of conflict. While this creates corporate opportunities for frugal innovation -e.g. the circular economy, recycling, increasing resource efficiency, and dematerialization - finding suitable ways to tackle these issues could be instrumental for governments' and corporations' license to operate.

Regarding water specifically, the UN Water department (2014) has argued that about two out of three people will live in water stressed areas by 2025. UNEP (Diop et al., 2008) confirms that resource shortages and environmental degradation (which often go hand in hand) risk becoming triggers for armed conflicts, especially in the Middle East and Africa. Gleick (2014) ties

water shortages to the rise of social unrest in Syria and the ensuing mass migrations that are flooding Europe. At the moment, Tibet – a mass provider of fresh water to a dozen nations downstream, serving over a third of global population directly and through feeding rivers like the Indian Ganges – is at the epicenter of the water debates in Asia. Given China's control over Tibet and its refusal to sign the 1997 UN Convention on the Non-Navigational Uses of International Watercourses, water remains "the most important global resource that does not have any international agreement" (Pearce, 2012). The treaty finally came into force on August 2014 but with only 36 ratifications, it still lacks broad support, especially from key nations.

When civil society is strong and has the backing of local governments, global companies like Coca-Cola are responding. Coca-Cola had been held accountable for creating water shortages and pollution in India and has reacted by setting ambitious water neutrality goals which it claims it will reach at the end of 2015 (Srivastava, 2015). This is not strictly an issue faced by developing countries, as Nestle has come under attack for its water extraction at record low prices in California, while the entire State suffered from shortages (Bernish, 2015). In August 2015 over 60 leading Western institutional investors - worth a total 2.6 trillion USD in assets - sent joint letters to 15 food and beverage companies, calling for increased water risk management and disclosure practices (McNally, 2015). Water preservation and sustainable management are thus becoming a financial imperative.

Researchers have found that individuals are willing to allocate scarce resources to people in need when resource allocation can be done efficiently, but not when the resource allocators feel that others are responsible for their own predicament (Skitka & Tetlock, 1992). More recently, Fisman et al. (2015) found that when playing a dictator game, the American elite favors efficiency over equality more than the average American. Hence only when the cost of resource redistribution

is very low, are elite citizens willing to come up with a fair and equitable distribution. Such issues of resource access, distribution, and power of controlling resources become dominant issues where management scholars can provide a meaningful thought leadership.

FROM SCARCITY TO SUSTAINABILITY: A CONVERSATION WITH TENG LIT LIAK

The complement to natural resource scarcity is sustainability – preserving and renewing natural resources extends the timeframe for resource use or mitigates its negative impact through regeneration and other processes. We highlight discussions with Teng Lit Liak who chairs the National Environmental Agency of Singapore to develop thematic challenges confronting natural resources and sustainability discussions from a practice and policy perspective, these include: (1) individual and societal attitudes and behaviors, (2) technology substitution and adoption, (3) agenda shaping, leadership and governance, and (4) approaches to sustainability.

A**ttitudes and Behaviors**

"When we think of protecting wildlife, we focus on lions and whales. Not that they are not important, but we forget the mangroves, the bumblebees, and the insects which are critical to our oceans and food ecosystems. We need our children to learn about ecological balance in the early years. We are like most people in the world -- detached from the natural world. Everybody agrees on global warming, but how many of us turn those ideas into action?"

Sustainability requires an attitude towards conservation and preservation of the earth's natural resources for the next generations. Yet, these attitudes are not widely shared. Even if individuals do share sustainability principles, their behavior is often guided by the constraints of the present. Education can help to imbue young minds with a sense of ecological balance, to counter the detachment from the natural world many of us subconsciously experience. These attitudes and behaviors towards sustainability practices become important predictors of investing in technologies or opportunities for the future. Sonenshein, DeCelles and Dutton (2014) study the

importance of self-evaluations and find that factors such as self-doubt play a crucial role in whether individuals waver in their support for environmental action.

Research on boards of directors and top management teams could investigate whether specific forms of short-term versus long-term compensation schemes affect companies' strategic directions when it comes to control over natural resources and investing in novel technologies. Cultural aspects likely play an important role as Asian countries embarking on growth might have differing incentives to mature economies of the West and have differing institutional and societal priorities and views of the world (Barkema et al., 2015). Are forward-thinking boards and managers less likely to engage in strictly symbolic actions? Do they implement resource mechanisms that do not burden future generations, for instance avoiding landfilling their products at the end of life and enacting recycle and reuse strategies? Such questions tap into the complex cultural, attitudinal, and behavioral influences on natural resource scarcity and sustainability.

Technology Substitution and Adoption

"Singapore is one of the few first world cities located in hot, humid weather. Yet, what is the difference between our skyline and London? It's identical. My point is this, all our buildings in Singapore can be covered with plants, on the roofs and balconies. If a super clean hospital can have a farm on the roof, you can have compact farming on every HDB flat (housing development board). One way is to spec the green replacement ratio from 1-to-1 to 1-to-3 or 1-to-5. We need to rethink how we design our buildings and how we use technology. Our farming can no longer use millions of acres, but we need to think of technology and compact farming. In the future, you will get your food straight from high density compact farms located in high rise green buildings. We need a whole new way to look at technology and its role in sustaining natural resources."

The technological challenge primarily consists of the risk of solving one problem while worsening another. Desalination of water is highly energy-intensive while reverse osmosis could have potentially negative health consequences due to demineralization, which makes effectively capturing and storing rainwater highly important. Frugal innovations for harvesting rainwater might not be as technologically advanced, but can contribute substantively to sustainability goals.

Alternatively, are natural resource constraints going to rejuvenate economic ideas around "small is beautiful", perhaps facilitated by technologies that allow for more distributed and decentralized ownership (Buterin, 2013; Schumacher, 1973)? It is likely that future farming practices will differ substantively from current practices, perhaps with rooftop farms and vertical gardens penetrating the skyline of cities and villages all over the world. What is the role that entrepreneurs play in sustainability shifts? Can institutional entrepreneurs help change the rules that have become counterproductive to the new objectives? Organizational scholars have opportunities to study shifts in production and consumption, as well as emergence and adoption of new technologies and practices. These questions raise several implications for theories of technology adoption and diffusion when market mechanisms are not the only ones at play.

Agenda Shaping, Leadership, and Governance

"The challenges of the future are more grounded than fanciful. You'll always need clean air, you need to eat, you need to keep the aircon on, and the trains running. Yet the big thing will be that we shift from coal generation to sustainable power. Global warming sooner than later is going to catch up with you, whether you deny it exists or not. Where we need leadership is to decide the direction and put all our efforts towards it. You need to look at how leaders and business can take responsibility and shape the agenda. It takes about four calories of energy to create one calorie of food, because of transport, packaging and manufacturing. We need solutions that cut across countries, businesses, and communities, and this takes leadership and a commitment for better governance globally."

In a recent economics article, Aghion and Roulet (2014) argue that developed nations have to become "Smart States" that vertically invest in sectors of strategic interest. This, the authors confess, will involve creative destruction, and hence requires a government that is willing to hit the hands that feeds it. It requires divesting in sectors in which a country has no advantage, and investing strategically in big challenges a country faces, that can be scaled across the globe. At the State level, this raises questions about re-education, and thus learning, unlearning, knowledge rigidity, and individual and institutionalized inertia. How does an economy transform the skills it

has into the skills it needs for the future? Shifts in strategic industries likely will provide avenues for scholars to examine the dynamics of motivation, change, and re-skilling workforce issues.

In addition, successfully maneuvering governmental, civil, and non-profit stakeholders is likely to be especially important in these contexts. China's Three Gorges Dam, the biggest electricity plant in the world, in combination with the South-to-North water project has forced the relocation of over 1.3 million people, has detrimental impact on water quality as algae grow excessively in stationary water, has contributed to the expansion of the Gobi Desert, and risks increasing the salinity of the Brahmaputra river in India (Lubin & Schafer, 2010). Given unpredictable externalities and complex resource interactions, firms will need to engage with stakeholders in proactive ways. Models of organizing that include public and private organizations working together with civil society to manage social resilience and welfare will raise new questions of organizational design, coordination, incentives, and goal alignment in shaping complex global agendas and implementing coordinated actions across nations and organizations (van der Vegt et al., 2015). For example, public-private partnership models in healthcare (e.g., Roehrich et al., 2012) may well be extended to natural resource sustainability initiatives that involve civil society, organizations and governments.

Approaches to Sustainability: Experimentation, Idealism, and Pragmatism

"We need leaders who can think big, think deeply, start small, and act fast. Thinking big is about breaking through existing boundaries, it is about imagination. You need to think deeply about problems and require applying rigor and expertise to ideas, explore and prototype. If we start small and in a sensible place, it's most likely going to catch on as an experiment. Acting fast requires us to have ambition, courage, and self-confidence. We need vision and a framework to get bold ideas to practice. What are good ways to lead change? How can we get business, government, and society to have a bolder vision and to act?"

How can governments and organizations stimulate the emergence of ecosystems around new technologies that have the potential to answer some of the Grand Challenges the world faces

regarding environmental sustainability, migration, health, and social balance? In these contexts, it is often scarcity that inspires great ideas and actions. Singapore has an advantage in the search for water technologies, because it virtually has no natural water sources of its own. Israel is an early adopter of electrical vehicles because it is keen to reduce its oil dependencies. The Dutch are global experts in the construction of dikes because without them, one could best visit the Netherlands on a scuba-diving tour. How do slack and problemistic search inspire different practices? Do organizations that hail from countries that face significant natural resource constraints benefit from their difficult access to resources? Is there a corporate equivalent of the resource curse? Scholarship and the evidence that management scholars generate have the potential to influence how organizations can adapt or, better yet, lead the charge to tackle scarcity and shift the emphasis to sustainability. We encourage management and organizational scholars to respond to the Grand Challenge of the scarcity and sustainability of Earth's natural resources by finding ways to engage business, government, and civil society productively as outlined in this editorial.

"The best way to make a living in this world is to find ways of solving problems that everybody has. Every society needs to find its own niche and solve the problems most pertinent to its development. How will it decide? How will it experiment? You need a combination of idealism and pragmatism. Resources can be bought, used, burnt or thrown away – that's pragmatic – but then there's also conservation and how you preserve the world for the next generation. Whether its recycling batteries or dumping e-waste, there is a business and social opportunity and a cost. At the current cost of oil, does it make sense to recycle plastic? If it is only market economics, likely not. But that also creates an entrepreneurial opportunity for us to find ways to recycle plastic at low cost. I believe that you need to err to the idealistic and push the boundary."

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Table 1: Usage of the Term "Resources" in AMJ

	Resource Framing	*Focal Theories*	*Representative AMJ articles*
People as resources	Individual attitudes, skills, and beliefs as drivers of performance outcomes	Self-regulation theory, social capital theory, behavioral theory, creativity theory, resource-based theory, conservation of resources, strategic HRM	Collins & Clark, 2003, Gong, 2003, Homan et al, 2008, Ertug and Castellucci, 2013, Gardner et al, 2012
	Aspects of hiring, firing, and turnover	Institutional theory, social contagion theory, agency theory, social exchange theory, theories on voice	Williamson & Cable, 2003, Shaw et al, 2009, Call et al, 2015, McClean et al, 2013
	Relational resources embedded in networks, outside directorships, trust, volunteering, boards	Network theory, Social Capital Theory, Behavioral Theory, Agency Theory, Resource dependence theory	Rodell, 2013, Chua et al, 2008, Getetkanycz & Boyd, 2011, McFadyen & Canella, 2004
Organizational assets as resources	Resource state as driver, e.g. lack, slack, compatibility, rigidity, distribution	Behavioral theory, Resource-based view, resource dependence theory, matching theory, organizational learning	George, 2005, Gilbert, 2005, Chatterjee, 1990, Mitsuhashi & Greve, 2009
	Resource type as driver, e.g. tech capability, reputation, status, knowledge	Resource-based view, transaction cost economics, institutional theory, agency theory	Mayer & Salomon, 2006, Jensen & Roy, 2008, He & Wang, 2009
	Resources in action, e.g. bundling, deployment, allocation, resourcing, resource sharing, trust	Resource-based view, real options, creativity process theory, strategic planning, social capital theory, agency theory,	Dyer, 1970, Daft, 1978, Sonenshein, 2014, Sirmon et al, 2008, Tsai & Ghoshal, 1998
Inter-organizational & societal resources	Business groups, certifications, governments, alliance partners' portfolio diversity	Signaling theory, Stakeholder theory, resource-based view, Network theory	Lamin, 2013, Polidoro, 2013, Hitt et al, 2006, Srivastava & Gnyawali, 2011
	Resource relatedness, imitation, or similarity, fit	Resource-based theory, competitive dynamics, institutional theory, resource dependence theory	Diestre & Rajagopalan, 2011, Polidoro & Khoon, 2011, Upson et al, 2012, Amezcua et al, 2013
	Environment and institutions	Institutional theory, Stakeholder theory	Chreim et al, 2007, Zilber, 2002, Wang & Qian, 2011

Table 2: Natural Resources in AMJ

	Predictors	*Outcomes Explained*	*Natural Resource Contexts*	*Representative AMJ publications*
Individual Roles and Effects	Age, job status, performance, policies	Mobility & Turnover	Coal mines, oil companies, steel minimills	Blumberg, 1980, Dreher, 1982, Arthur, 1994
	Training, autonomy	Work attitudes	Steel plant, mineral plant	Cordery et al, 1991, Hand & Slocum, 1970
	Team building, diversity, regulation quality	Performance	Metal mine, oil and gas, electric utility	Buller & Bell, 1986, van der Vegt & Bunderson, 2005
	Mood, life quality	Originality	Oil fields, urban/rural	George & Jing, 2007, Pennings, 1982
	Absorptive capacity, clustering	Network changes	Food, petrochemical, steel	Tsai, 2001, Madhavan et al, 2004
Individual Attitudes	Attitude, norms, control	Preferences	Environmental managers	Cordano & Hanson Frieze, 2000
	Eco-centricity, openness, self-transcendence	Difference between environmental and other organizations	Leaders of profit & non-profits	Egri & Herman, 2000
	Norms, attitudes, issue interpretation	Ethical / environmental Decision-making	US Metal finishing industry, oil and gas; students supporting climate change issues	Flannery & May, 2000, Sharma, 2000; Sonenshein, DeCelles and Dutton, 2014.
	Land identification, reciprocity, ecological respect, physical location	Ecological Embeddedness	Ethnography of a Cree tallyman	Whiteman & Cooper, 2000
	Standards	Judgments of environmental solutions	Business students doing arsenic emission exercise	Tenbrunsel et al., 2000
Organizational Attitudes and Performance	Philanthropy, legitimacy, best practices	Financial results	Chinese listed firms, chemical industry	Christman, 2000, Diestre & Rajagopalan, 2014, Wang & Qian, 2011
	Public affairs management, stakeholder pressure	Social and environmental results	Forest Product & polluting industries	Bhambri & Sonnenfel, 1988, Kassinis & Vafeas, 2006
	Stakeholder demands	Standardization of global environmental policies	Chemical industry	Christmann (2004)
	Environmental proactivity	Perceptions of stakeholder importance	Firms across various industries	Henriques and Sadorsky (1999)
	Proactive business strategies	Corrective and preventative natural environment approaches	Firms across various industries	Aragon-Correa (1998)

Table 3: Scarce materials and exemplary industrial applications

Material	Key Applications	
Antimony	Flame retardants, ATO, lead-alloys, micro capacitors	
Beryllium	Copper alloys, aerospace, X-ray equipment	
Cadmium	Batteries, electroplating, nuclear fission, surface coating, color television	
Chromium	Seawater desalination, marine technologies	
Cobalt	Lithium-ion batteries, synthetic fuels	
Copper	Efficient electric motors, RFID	
Fluorspar (fluorite)	Hydrogen fluoride, steel production, opalescent glass, telescopes, lenses,	
Gallium	Thin layer PV, IC, WLED	
Germanium	Fiber optic cable, IR optical technology	
Graphite	Refractories, steelmaking	
Helium	Cooling of superconducting magnets (in MRIs), pressurizing and purging systems, maintenance of controlled atmospheres & arc welding	
Indium	Displays, thin layer PV	
Lithium	Ceramics and glass, batteries for EVs, lubricants, nuclear, medicine	
Magnesium	Structural metal	
Molybdenum	Structural and stainless steel, electronics, chemicals, cast iron, super alloys, fertilizer, medical imaging, solid lubricant	
Niobium	Micro capacitors, ferroalloys	
Platinum	Fuel cells, catalysts	Platinum Group Metals
Palladium	Catalysts, seawater desalination	
Ruthenium	Dye-sensitized solar cells, Ti-alloying element	
Cerium	Catalysts (Diesel), precision polishing, metal alloys	Rare Earth Elements
Dysprosium	Laser technology, lighting, nuclear control rods, magnets, hybrid engines	
Europium	Dopant in optoelectronics & lasers, red phosphors (TV), fluorescent lamps	
Lanthanum	Batteries for EVs, hydrogen sponge alloys	
Neodymium	Permanent magnets, petroleum refining, hard drives in laptops	
Scandium	Solid Oxide Fuel Cells, aluminum alloying (aerospace)	
Terbium	"Green" phosphors (TV), fluorescent lamps, permanent magnets	
Yttrium	Super conduction, laser technology	
Selenium	Thin layer PV, alloying element	
Silver	RFID, lead-free soft solder	
Tantalum	Micro capacitors, medical technology	
Tellurium	Steel or copper alloys, semiconductors, PV, ceramics	
Tin	Lead-free soft solder, transparent electrodes	
Titanium	Seawater desalination, implants	
Tungsten (wolfram)	Hard materials, heavy metal alloys, armaments, lubricant	
Uranium	Nuclear energy	
Vanadium	Steel additive, super-conduction, glass coatings, coloring, batteries	
Zirconium	High temperature applications, opacifier, cladding nuclear reactor fuels	

REFERENCES

Aghion, P. & Roulet, A. 2014. Growth and the Smart State. ***Annual Review of Economics***, 6(1): 913-926.

Allwood, J. M., Ashby, M. F., Gutowski, T., G., & Worrel, E. 2011. Material Efficiency: A white paper. ***Resources, Conservation and Recycling***, 55(3): 362-381.

Amezcua, A. S., Grimes, M. G., Bradley, S. W., & Wiklund, J. 2013. Organizational sponsorship and founding environments: a contingency view on the survival of business-incubated firms, 1994-2007. ***Academy of Management Journal***, 56(6): 1628-1654.

Apodaca, C. 2012. Human Rights Violations in an Era of Scarcity: 1-39. Virginia: Virginia Tech.

Aragon-Correa, J. A. 1998. Strategic proactivity and firm approach to the natural environment ***Academy of Management Journal*** 41(5): 12.

Arthur, J. B. 1994. Effects of human resource systems on manufacturing performance and turnover. ***Academy of Management Journal***, 37(3): 670-687.

Barkema, H., Chen, X.P., George, G., Luo, Y., Tsui, A. 2015. West meets east: new concepts and theories. ***Academy of Management Journal***, 58(2): 460-479.

Barney, J. B. 1991. Firm resources and sustained competitive advantage ***Journal of Management*** 17(1): 99-120.

Bernish, C.; The Privatization of Water: Nestlé Pays Only $524 to Extract 27,000,000 Gallons of California Drinking Water; http://theantimedia.org/nestle-pays-only-524-to-exract-27000000-gallons-of-california-drinking-water/; Sep 30, 2015.

Bhambri, A. & Sonnenfeld, J. 1988. Organization structure and corporate social performance: a field study in two contrasting industries. ***Academy of Management Journal***, 31(3): 642-662.

Blumberg, M. 1980. Job switching in autonomous work groups: an exploratory study in a Pennsylvania coal mine. ***Academy of Management Journal***, 23(2): 287-306.

BMWi. 2010. The German Government's raw materials strategy: Safeguarding a sustainable supply of non-energy mineral resources for Germany. In Federal Ministery of Economics and Technology (Ed.). Berlin: Federal Ministery of Economics and Technology,.

Bode, C., Wagner, S. M., Petersen, K. J., & Ellram, L. M. 2011. Understanding responses to supply chain disruptions: Insights from information processing and resource dependence perspectives. ***Academy of Management Journal***, 54(4): 833-856.

Boone, C. & Özcan, S. 2014. Why do cooperatives emerge in a world dominated by corporations? The diffusion of cooperatives in the US bio-ethanol industry, 1978–2013. ***Academy of Management Journal***, 57(4): 990-1012.

Brown, G. M. & Field, B. C. 1978. Implications of alternative measures of natural resource scarcity ***Journal of Political Economy***, 86(2): 229-243.

Buijs, B. & Sievers, H. 2012. Resource Security Risks in Perspective - Complexity and Nuance: 1-49. The Netherlands: Polinares.

Buller, P. F. & Bell Jr, C. H. 1986. Effects of team building and goal setting on productivity: a field experiment. ***Academy of Management Journal***, 29(2): 305-328.

Buterin, V. 2013. Bootstrapping a Decentralized Autonomous Corporation: Part 1. ***Bitcoin Magazine***, online.

Call, M. L., Nyberg, A. J., Ployhart, R. E., & Weekley, J. 2015. The dynamic nature of collective turnover and unit performance: the impact of time, quality, and replacements. ***Academy of Management Journal***, 58(4): 1208-1232.

Carrington, D. 2015. World's biggest sovereign wealth fund dumps dozens of coal companies ***The Guardian***. London: http://www.theguardian.com/environment/2015/feb/05/worlds-biggest-sovereign-wealth-fund-dumps-dozens-of-coal-companies.

Chatterjee, S. 1990. Excess resources, utilization costs, and mode or entry. ***Academy of Management Journal***, 33(4): 780-800.

Chen, K. 2012. Could your language affect your ability to save money, ***TED Global***: TED.

Chreim, S., Williams, B. E., & Hinings, C. R. 2007. Interlevel influences on the reconstruction of professional role identity. ***Academy of Management Journal***, 50(6): 1515-1539.

Christmann, P. 2000. Effects of "Best Practices" of Environmental Management on Cost Advantage: The Role of Complementary Assets. ***Academy of Management Journal***, 43(4): 663-680.

Chua, R. Y. J., Ingram, P., & Morris, M. W. 2008. From the head and the heart: locating cognition- and affect-based trust in managers' professional networks. ***Academy of Management Journal***, 51(3): 436-452.

Collins, C. J. & Clark, K. D. 2003. Strategic human resource practices, top management team social networks, and firm performance: the role of human resource practices in creating organizational competitive advantage. ***Academy of Management Journal***, 46(6): 740-751.

Cordano, M. & Frieze, I. H. 2000. Pollution reduction preferences of U.S. environmental managers: applying Ajzen's theory of planned behavior. ***Academy of Management Journal***, 43(4): 627-641.

Cordery, J. L., Mueller, W. S., & Smith, L. M. 1991. Attitudinal and behavioral effects of autonomous group working: a longitudinal field study. ***Academy of Management Journal***, 34(2): 464-476.

Daft, R. L. 1978. System Influence on Organizational Decision Making: The Case of Resource Allocation. ***Academy of Management Journal***, 21(1): 6-22.

Dean, T. J. & Brown, R. L. 1995. Pollution regulation as a barrier to new firm entry: Initial evidence and implications for future research. ***Academy of Management Journal***, 38(1): 288-303.

Defra. 2011a. Resource Security Action Plan: Making the most of valuable materials. In Department for Environment Food and Rural Affairs & Department for Business Innovation & Skills (Eds.): 1-56. London: Defra.

Defra. 2011b. Government Review of Waste Policy in England 2011. In Department for Environment Food and Rural Affairs (Ed.): 1-80: Defra.

Diestre, L. & Rajagopalan, N. 2011. An Environmental Perspective on Diversification: The Effects of Chemical Relatedness and Regulatory Sanctions. ***Academy of Management Journal***, 54(1): 97-115.

Diestre, L. & Rajagopalan, N. 2014. Toward an input-based perspective on categorization: investor reactions to chemical accidents. ***Academy of Management Journal***, 57(4): 1130-1153.

Diop, S., M'mayi, P., & Lisbjerg, D. 2008. Vital Water Graphics: An Overview of The State of the World's Fresh and Marine Waters. In S. Diop & P. Rekacewicz (Eds.), Vol. 2: http://www.unep.org/dewa/vitalwater/: United Nations Environment Programme.

Dreher, G. F. 1982. The Role of Performance in the Turnover Process. ***Academy of Management Journal***, 25(1): 137-147.

Dyer, J. H. & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. ***Academy of Management Review***, 23(4): 660-679.

Dyer, J. S. 1970. The Use of PPBS In a Public System of Higher Education: "Is it Cost-Effective?". ***Academy of Management Journal***, 13(3): 285-299.

EEF. 2012. Executive Survey 2012: Manufacturers' views on the economy and their own prospects in 2012. In EEF The Manufacturers' organization (Ed.): 1-15: EEF.

Egri, C. P. & Herman, S. 2000. Leadership in the north american environmental sector: values, leadership styles, and contexts of environmental leaders and their organizations. ***Academy of Management Journal***, 43(4): 571-604.

Ernst & Young. 2011. Technology Minerals, the rare earths race is on: 28: Ernst & Young.

Ernst & Young. 2012. Preparing for water scarcity: Raising business awareness on water issues. In E. Young (Ed.): 24: Ernst & Young.

Ernst & Young. 2013. Six growing trends in corporate sustainability: 1-36: EYGM Limited.

Ertug, G. & Castellucci, F. 2013. Getting what you need: how reputation and status affect team performance, hiring, and salaries in the NBA. ***Academy of Management Journal***, 56(2): 407-431.

European Commission 2010. ***Critical Raw Materials for the EU - Report of the Ad-hoc Working Group on defining critical raw materials***. In Raw Materials Supply Group (Ed.): 1-84. Brussels: European Commission.

European Commission. 2011. ***Roadmap to a Resource Efficient Europe***: ***26***. Brussels: European Commission.

Fernández, E., Montes, J. M., & Vázquez, C. J. 2000. Typology and strategic analysis of intangible resources: a resource-based approach. ***Technovation***, 20(2): 81-92.

Fisman, R., Jakiela, P., Kariv, S., & Markovits, D. 2015. The distributional preferences of an elite. ***Science***, 349(6254): 1300-1307.

Flannery, B. L. & May, D. R. 2000. Environmental ethical decision making in the u.s. metal-finishing industry. ***Academy of Management Journal***, 43(4): 642-662.

Gardner, H. K., Staats, B. R., & Gino, F. 2012. Dynamically integrating knowledge in teams: transforming resources into performance. ***Academy of Management Journal***, 55(4): 998-1022.

Geletkanycz, M. A. & Boyd, B. K. 2011. CEO outside directorships and firm performance: a reconciliation of agency and embeddedness views. ***Academy of Management Journal***, 54(2): 335-352.

George, G. 2005. Slack resources and the performance of privately held firms. ***Academy of Management Journal***, 48(4): 661-676.

George, J. M. & Jing, Z. 2007. Dual tuning in a supportive context: joint contributions of positive mood, negative mood, and supervisory behaviors to employee creativity. ***Academy of Management Journal***, 50(3): 605-622.

Gong, Y. 2003. Subsidiary staffing in multinational enterprises: agency, resources, and performance. ***Academy of Management Journal***, 46(6): 728-739.

Gilbert, C. 2005. Unbundling the structure of inertia: resource versus routine rigidity. ***Academy of Management Journal***, 48(5): 741-763.

Gleick, P. H. 2014. Water, drought, climate change, and conflict in Syria. ***Weather, Climate, and Society***, 6(3): 331-340.

Grant, R. M. 1999. The resource-based theory of competitive advantage: implications for strategy formulation. In M. H. Zack (Ed.), ***Knowledge and strategy***, Vol. 33: 3-23. Boston: Butterworth Heindemann.

Grantham, J. 2012. ***Attitudes in America to investing, resource limitations and global warming***. Paper presented at the Imperial College Lectures, London.

Gurr, T. T. 1985. On the political consequences of scarcity and economic decline. ***International Studies Quartely***, 29(1): 25.

Hand, H. H. & Slocum Jr, J. W. 1970. Human Relations Training for Middle Management: A Field Experiment. ***Academy of Management Journal***, 13(4): 403-410.

Hardy, C. & Maguire, S. 2010. Discourse, field-configuring events, and change in organizations and institutional fields: narratives of DDT and the Stockholm Convention. ***Academy of Management Journal***, 53: 1365-1392.

Hayes-Labruto, L., Schillebeeckx, S. J. D., Workman, M., & Shah, N. 2013. Contrasting perspectives on China's rare earth policies: reframing the debate through a stakeholder lens. ***Energy Policy***, 63, 55-68.

He, J. & Wang, H. C. 2009. Innovative knowledge assets and economic performance: the asymmetric roles of incentives and monitoring. ***Academy of Management Journal***, 52(5): 919-938.

Heffernan, T. 2015. The U.S.'s only rare-earth mine files for bankruptcy, ***High Country News***. online.

Henriques, I. & Sadorsky, P. 1999. The relationship between environmental commitment and managerial perceptions of stakeholder importance. ***Academy of Management Journal***, 42(1): 87-99.

Herlocker, C. E., Allison, S. T., Foubert, J. D., & Beggan, J. K. 1997. Intended and unintended overconsumption of physical, spatial, and temporal resources. ***Journal of Personality and Social Psychology***, 73(5): 992.

Hiatt, S. R. & Sangchan, P. 2013. Lords of the harvest: Third party influence and regulatory approval of genetically modified organisms. ***Academy of Management Journal***, 56(4): 923-944.

Hitt, M. A., Bierman, L., Uhlenbruck, K., & Shimizu, K. 2006. The importance of resources in the internationalization of professional service firms: the good, the bad, and the ugly. ***Academy of Management Journal***, 49(6): 1137-1157.

Hoffman, A. J. 1999. Institutional evolution and change: Environmentalism and the U.S. chemical industry. ***Academy of Management Journal***, 42(4): 351-371.

Homan, A. C., Hollenbeck, J. R., Humphrey, S. E., Van Knippenberg, D., Ilgen, D. R., & Van Kleef, G. A. 2008. Facing differences with an open mind: openness to experience, salience of intragroup differences, and performance of diverse work groups. ***Academy of Management Journal***, 51(6): 1204-1222.

Hook, L., Chaffin, J., & Beattie, A. 2012. US to challenge China over rare earths ***Financial Times***.

Hotelling, H. 1931. The Economics of Exhaustible Resources. ***Journal of Political Economy***, 29(2): 40.

Howard-Grenville, J., Buckle, S. J., Hoskins, B. J., & George, G. 2014. Climate change and management. ***Academy of Management Journal***, 57(3): 615-623.

Humphries, M. 2012. Rare Earth Elements: The Global Supply Chain. In C. R. Service (Ed.): 31. Washington.

Jensen, M. & Roy, A. 2008. Staging exchange partner choices: when do status and reputation matter? ***Academy of Management Journal***, 51(3): 495-516.

Joshi, A., Neely, B., Emrich, C., Griffiths, D., & George, G. 2015. Gender research in AMJ: An overview of five decades of research and call to action. ***Academy of Management Journal***, 58(5): 1459-1475.

Kassinis, G. & Vafeas, N. 2006. Stakeholder pressures and environmental performance. ***Academy of Management Journal***, 49(1): 145-159.

Lamin, A. 2013. Business groups as information resource: an investigation of business group affiliation in the indian software services industry. ***Academy of Management Journal***, 56(5): 1487-1509.

Lee, B. H. 2009. The infrastructure of collective action and policy content diffusion in the organic food industry. ***Academy of Management Journal***, 52(6): 1247-1269.

Lubin, G. & Schafer, I. 2010. 17 Earthshaking facts about the Three Gorges Dam and China's next even bigger water project, ***Business Insider***: Business Insider Inc.

Madhavan, R., Gnyawali, D. R., & Jinyu, H. 2004. Two's company, three's a crowd? Triads in cooperative-competitive networks. ***Academy of Management Journal***, 47(6): 918-927.

Madsen, P. M. 2009. Does corporate investment drive a "race to the bottom" in environmental protection? A reexamination of the effect of environmental regulation on investment. ***Academy of Management Journal***, 52(6): 1297-1318.

Maguire, S. & Hardy, C. 2009. Discourse and deinstitutionalization: the decline of DDT. ***Academy of Management Journal***, 52: 148-178.

Malthus, T. R. 1798. ***An Essay on the Principle of Population***. New York: Cosimo.

Marcus, A. A. 1988. Implementing externally induced innovations: a comparison of rule-bound and autonomous approaches. ***Academy of Management Journal***, 31(2): 235-256.

Martin, R. 2011. Molycorp's $1 billion rare-earth gamble, ***Fortune***. online.

Mayer, K. J. & Salomon, R. M. 2006. Capabilities, contractual hazards, and governance: integrating resource-based and transaction cost perspectives. ***Academy of Management Journal***, 49(5): 942-959.

McClean, E. J., Burris, E. R., & Detert, J. R. 2013. When does voice lead to exit? it depends on leadership. ***Academy of Management Journal***, 56(2): 525-548.

McDonough, W. & Braungart, M. 2002. ***Cradle to cradle: Remaking the way we make things***: North Point Pr.

Mcdonough, W. 2007. Cradle to Cradle Design. In TED (Ed.), ***TED Talks***: TED.

McFadyen, M. A. & Cannella, A. A. 2004. Social capital and knowledge creation: Diminishing returns of the number and strength of exchange relationships. ***Academy of Management Journal***, 47(5): 735-746.

McNally, B. W. 2015. Coca-Cola on Track to Being Water Neutral by End of 2015, ***Supply Chain***: online.

Meadows, D., Randers, J., & Meadows, D. 2004. ***Limits to growth: the 30-year update***. USA: Chelsea Green Publishing.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. 1972. ***The limits to growth***. New York: Potomac Associates.

Mitsuhashi, H. & Greve, H. R. 2009. A matching theory of alliance formation and organizational success: Complementarity and compatibility. ***Academy of Management Journal*** 52(5): 975-995.

Miyazaki, T. 2012. Japan, India reach rare earth deal, ***The Jakarta Post***. www.thejakartapost.com.

Osborn, R. N. & Jackson, D. H. 1988. Leaders, riverboat gamblers, or purposeful unintended consequences in the management of complex, dangerous technologies. ***Academy of Management Journal***, 31(4): 924-947.

Parikh, P., Chaturvedi, S., George, G. 2012. The effects of energy provision on individual aspiration in slum communities, ***Energy Policy***, 50: 477-485.

Parikh, P., Fu, K., Parikh, H., McRobie, A., & George, G. 2015. Infrastructure Provision, Gender, and Poverty in Indian Slums. ***World Development***, 66(Feb): 468-486.

Pearce, F. 2012. A Global Treaty on Rivers: Key to True Water Security, ***Reporting, Analysis, Opinion & Debate***, Vol. 2015: Yale School of Forestry & Environmental Studies.

Pennings, J. M. 1982. The Urban Quality of Life and Entrepreneurship. ***Academy of Management Journal***, 25(1): 63-79.

Polidoro Jr, F., Toh, P.K. 2011. Letting rivals come close or warding them off? the effects of substitution threat on imitation deterrence. ***Academy of Management Journal***, 54(2): 369-392.

Polidoro Jr, F. 2013. The competitive implications of certifications: the effects of scientific and regulatory certifications on entries into new technical fields. ***Academy of Management Journal***, 56(2): 597-627.

Powell, E. E. & Baker, T. 2014. It's what you make of it: Founder identity and enacting strategic responses to adversity. ***Academy of Management Journal***, 57(5): 1406-1433.

PWC. 2011. The true value of water: Best practices for managing water risks and opportunities. In PWC (Ed.), ***A PwC Flobal Best Practices Focus Paper***: 19: PriceWaterhouseCooper.

Ramus, C. A. & Steger, U. 2000. The roles of supervisory support behaviors and environmental policy in employee "ecointiatives" at leading-edge European companies. ***Academy of Management Journal***, 43(4): 605-626.

Ricardo, D. 1817. On the principles of political economy and taxation. In J. Murray (Ed.). London: John Murray.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., & Schellnhuber, H. J. 2009. Planetary boundaries: exploring the safe operating space for humanity. ***Ecology and Society***, 14(2): 32.

Rodell, J. B. 2013. Finding meaning through volunteering: why do employees volunteer and what does it mean for their jobs? ***Academy of Management Journal***, 56(5): 1274-1294.

Roehrich, J., Lewis, M., George, G. 2014. Are Public-Private Partnerships a healthy option? A systematic review. ***Social Science & Medicine***, 113: 110-119.

Rojas, F. 2010. Power through institutional work: acquiring academic authority in the 1968 third world strike. ***Academy of Management Journal***, 53(6): 1263-1280.

Rulli, M. C. & D'Odorico, P. 2014. Food appropriation through large scale land acquisitions. ***Environmental Research Letters***, 9(6): 1-8.

Schillebeeckx, S. J., Parikh, P., Bansal, R., & George, G. 2012. An integrated framework for rural electrification: Adopting a user-centric approach to business model development. ***Energy Policy***, 48(Sep): 687-697.

Schoolderman, H. & Mathlene, R. 2011. Minerals and metals scarcity: the ticking timebomb: 1-26: PriceWaterhouseCooper.

Schumacher, E. F. 1973. Small is beautiful: a study of economics as if people mattered: Random House.

Schüssler, E., Rüling, C.-C., & Wittneben, B. B. F. 2014. On melting summits: the limitations of field-configuring events as catalysts of change in transnational climate policy. ***Academy of Management Journal***, 57(1): 140-171.

Sharma, S. 2000. Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. ***Academy of Management Journal***, 43(4): 681-697.

Sharpley, A. & Beegle, D. 2001. Managing Phosphorus for Agriculture and the Environment. In P. S. University (Ed.): 16. Pennsylvania College of Agricultural Sciences Agricultural Research and Cooperative Extension.

Shaw, J. D., Dineen, B. R., Fang, R., & Vellella, R. F. 2009. Employee-organization exchange relationships, hrm practices, and quit rates of good and poor performers. ***Academy of Management Journal***, 52(5): 1016-1033.

Sirmon, D., Gove, S. & Hitt, M.A. 2008. Resource management in dyadic competitive rivalry: The effects of resource bundling and deployment. ***Academy of Management Journal***, 51(5): 919-935.

Skitka, L. J. & Tetlock, P. E. 1992. Allocating scarce resources: A contingency model of distributive justice. ***Journal of Experimental Social Psychology***, 28(6): 491-522.

Smaller, C. & Mann, H. 2009. A Thirst for Distant Lands: Foreign investment in agricultural land and water. In International Institute for Sustainable Development (iisd) (Ed.), ***Foreign Investment for Sustainable Development Program***: 1 - 26. Winnipeg, Manitoba.

Sonenshein, S. 2014. How Organizations foster the creative use of resources**,** ***Academy of Management Journal,*** 57(3): 814-848**.**

Sonenshein, S., DeCelles, K., Dutton, J. 2014. It's not easy being green: the role of self-evaluations in explaining support of environmental issues, ***Academy of Management Journal***, 57(1): 7-37.

Srivastava, A.; The Privatization of Water in India: How Coca-Cola destroys the Aquifer; http://www.globalresearch.ca/the-privatization-of-water-in-india-how-cocacola-destroys-the-aquifer/5472625; Sep 30, 2015.

Srivastava, M. K. & Gnyawali, D. R. 2011. When do relational resources matter? leveraging portfolio technological resources for breakthrough innovation. ***Academy of Management Journal***, 54(4): 797-810.

Tenbrunsel, A. E., Wade-Benzoni, K. A., Messick, D. M., & Bazerman, M. H. 2000. Understanding the influence of environmental standards on judgments and choices. ***Academy of Management Journal***, 43(5): 854-866.

Tsai, W. & Ghoshal, S. 1998. Social capital and value creation: the role of intrafirm networks. ***Academy of Management Journal***, 41(4): 464-476.

Tsai, W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. ***Academy of Management Journal***, 44(5): 996-1004.

UN-Water. 2014. A Post-2015 Global Goal for Water: Synthesis of key findings and recommendations from UN-Water. In UN-Water (Ed.): 41: United Nations.

United Nations. 2012. ***The Millenium Development Goals Report 2012***. Geneva, Switzerland: United Nations.

Upson, J. W., Ketchen Jr, D. J., Connelly, B. L., & Ranft, A. L. 2012. Competitor analysis and foothold moves. ***Academy of Management Journal***, 55(1): 93-110.

US Department of Energy. 2011. ***Critical Material Strategy***: 1-196.

US National Academy of Sciences. 2008. ***Minerals, Critical Minerals, and the US Economy. In Committee on Critical Mineral Impacts of the U.S. Economy***, Committee on Earth Resources & US National Research Council (Eds.): 264. Washington: The National Academic Press.

US National Research Council. 2008. ***Managing Materials for a Twenty-first Century Military***. In Committee on Assessing the Need for a Defense Stockpile (Ed.): 1-208. Washtington D.C.: National Academies Press.

van der Vegt, G. S. & Bunderson, J. S. 2005. Learning and performance in multidisciplinary teams: the importance of collective team identification. ***Academy of Management Journal***, 48(3): 532-547.

van der Vegt, G. S., Essens, P., Wahlström, M., & George, G. 2015. Managing Risk and Resilience. ***Academy of Management Journal***, 58(4): 971-980.

Vateva, A. 2012. China's Rare-Earth Elements Policy and its Implications for Germany, Japan and the USA, ***UfU-Papers***: 94. Berlin: Unabhängiges Institut für Umweltfragen e.V.,.

Wang, H. & Qian, C. 2011. Corporate philanthropy and corporate financial performance: the roles of stakeholder response and political access. ***Academy of Management Journal***, 54(6): 1159-1181.

Whiteman, G. & Cooper, W. H. 2000. Ecological embeddedness. ***Academy of Management Journal***, 43(6): 1265-1282.

Williamson, I. O. & Cable, D. M. 2003. Organizational hiring patterns, interfirm network ties, and interorganizational imitation. ***Academy of Management Journal***, 46(3): 349-358.

Workman, M., Dean, C., Schillebeeckx, S. J. D., & Shah, N. 2016. Modern resource scarcity: Sinks, complexity, and managing risks, ***Grantham Institute for Climate Change Series***. London: Grantham Institute for Climate Change.

Zilber, T. B. 2002. Institutionalization as an interplay between actions, meanings, and actors: the case of a rape crisis center in israel. ***Academy of Management Journal***, 45(1): 234-254.