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The Development of a Payment Regime for Deep Sea Mining Activities in the Area through Stakeholder Participation

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Abstract

In July 2015, the Council of the International Seabed Authority (ISA) adopted seven priority deliverables for the development of the exploitation code. The first priority was the development of a zero draft of the exploitation regulations. This article focusses on the second priority deliverable, namely the development of a payment mechanism for exploitation activities, following detailed financial and economic models based on proposed business plans. Between 2015 and 2017, five workshops have been organised with 196 active participants from 34 countries. The results so far are synthesised, drawing upon the outcome of these workshops, ISA technical papers, and the scholarly literature.

Keywords

payment regime – exploitation regulation – polymetallic nodules – stakeholder participation – International Seabed Authority – Law of the Sea Convention (LOSC)

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Introduction[1]

This article synthesises the outcomes of five workshops held on the Deep Seabed Mining (DSM) payment regime sponsored by the International Seabed Authority (ISA) along with various partners (see Table 1). These workshops formed an integral part of the implementation of the requirements for a financial regime for DSM activities in/on the seabed and ocean floor and subsoil thereof beyond national jurisdiction (the Area) set out in the Law of the Sea Convention (LOSC), the legally binding instrument that governs these activities.[2]

Entities that are qualified to undertake DSM in the Area include States Parties, State enterprises and natural and juridical persons when sponsored by States Parties. For ease of reference, the term 'contractor' is used in this document as a collective reference to all such entities. The workshops convened-representatives from contractors (32%), industry experts (8%), civil society

TABLE 1 Financial Payment Regime workshops

1	Joint CIL-ISA Workshop on Mineral Exploitation in the Area[a]	17 June 2015	Singapore
2	Toward Transparency and Best Practices for Deep Seabed Mining: An Initial Multi-Stakeholder Meeting	7–9 October 2015	Bellagio
3	Deep Seabed Mining Payment Regime Workshop No. 1: The Design of a Payment Regime	17–18 May 2016	San Diego
4	Deep Seabed Mining Payment Regime Workshop No. 2: Cost Components of a Financial Model	1–2 December 2016	London
5	Deep Seabed Mining Payment Regime Workshop No. 3: Developing a Financial Modeling Framework	19–21 April 2017	Singapore

a CIL is the Center for International Law of the National University of Singapore

1 The views expressed in this article are those of the authors, and do not necessarily reflect the position of the International Seabed Authority or the respective institutions. The authors of this article would like to acknowledge the contribution of all workshop participants. This synthesis is a result of the collaborative and transparent discussions between regulators, contractors, industry experts, civil society, academics, international organisations, State parties and policy makers.

2 United Nations Convention on the Law of the Sea (Montego Bay, 10 December 1982, in force 16 November 1994) 1833 *UNTS* 3.

and academic communities (27%), national governments (17%), and international organisations (16%) to discuss the design of a payment regime for DSM. The primary focus of this article is to assess various payment mechanisms for DSM activities in the Area, thereby contributing to a financial model to evaluate financial impacts from these payment mechanisms and the drafting of financial terms for exploitation contracts. This article synthesises the above assessment, drawing on results from the workshops, ISA technical papers, and the scholarly literature.[3]

3 International Seabed Authority, Towards the Development of a Regulatory Framework for Polymetallic Nodule Exploitation in the Area (Technical Study No. 11) (ISA, Kingston, Jamaica, 2013), available at https://www.isa.org.jm/news/isa-issues-technical-study-11-available-online; accessed 30 April 2019; International Seabed Authority, Draft Regulations on Exploitation of Mineral Resources in the Area (ISBA/24/LTC/WP.1. 30 April 2018), available at https://www.isa.org.jm/document/isba24ltcwp1; accessed 30 April 2019; International Seabed Authority, Draft Regulations on Exploitation of Mineral Resources in the Area (ISBA/24/LTC/WP.1/Rev.1. 9 July 2018), available at https://www.isa.org.jm/document/isba24ltcwp1rev1; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – A Discussion Paper on the Development and Drafting of Regulations on Exploitation for Mineral Resources in the Area (Environmental Matters) (ISA, Kingston, Jamaica, 2017), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/DraftExpl/DP-EnvRegsDraft25117.pdf; accessed 30 April 2019; International Seabed Authority, Draft Regulations on Exploitation of Mineral Resources in the Area (ISBA/23/LTC/CRP.3*, 8 August 2017); available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/DraftExpl/ISBA23-LTC-CRP3-Rev.pdf; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – Report to Members of the Authority and All Stakeholders (First Working Draft) (ISA, Kingston, Jamaica, 2016), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/DraftExpl/Draft_ExplReg_SCT.pdf; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – Report to Members of the Authority and All Stakeholders (Draft Framework) (ISA, Kingston, Jamaica, 2015), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Survey/Report-2015.pdf; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – A Discussion Paper on the Development and Implementation of a Payment Mechanism in the Area for Consideration by Members of the Authority and All Stakeholders (ISA, Kingston, Jamaica, 2015), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/WorkingPapers/DiscussionPaper-FinMech.pdf; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – Draft Framework, High Level Issues and Action Plan, Version II (ISA, Kingston, Jamaica, 2015), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/OffDocs/Rev_RegFramework_ActionPlan_14072015.pdf; accessed 30 April 2019; International Seabed Authority, Workshop on Mineral Exploitation in the Area: Joint CIL-ISA Workshop Report, 16–17 June 2015, Singapore (Briefing Paper 04/15) (ISA, Kingston, Jamaica, 2015), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/files/documents/bp4–final-web.pdf; accessed 30 April 2019; International Seabed Authority, Developing a Regulatory Framework for Mineral Exploitation in the Area – Stakeholder engagement (ISA, Kingston, Jamaica, 2014),

Facts and Principles

Deep Sea Mining

Mineral prices display considerable volatility over time, generating long-term cyclical swings in revenue. Mining requires lengthy periods of exploration and development during which no revenue is generated. DSM equipment is highly specialised, and much of the technology remains under development, further lengthening the time prior to mining and increasing risk. Sources of risk include exploration, mineral prices, cost uncertainty, technology development, environmental damage, and policy-regulatory uncertainty. The amount of capital required during the development and construction phase is relatively larger than in most other industries. Once the mine is developed, much of the capital forms a sunk cost (a fixed cost that is not recoverable). Mines can have long lives, making them potentially subject to payment regime changes and policy instability: this is called time inconsistency (when actions specified are optimal for a party at the making of the agreement, but when the time comes to perform the action, the action may not be optimal). The long time periods involved, large upfront but sunk capital costs, technology still under development, substantial transition time to mining, uncertain reserves and environmental impacts, a still-emerging regulatory and fiscal framework, and mineral

available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/isa-ssurvey.pdf; accessed 30 April 2019; International Seabed Authority, Making the Most of Deep Seabed Mineral Resources – Developing Financial Terms for Deep Sea Mining Exploitation (ISA, Kingston, Jamaica, 2014), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/FinTerms2014.pdf; accessed 30 April 2019; MW Lodge, K Segerson and D Squires, 'Sharing and Preserving the Resources in the Deep Sea: Challenges for the International Seabed Authority' (2017) 32(3) *International Journal of Marine and Coastal Law* (*IJMCL*) 427–457; International Seabed Authority, Deep Seabed Mining Payment Regime Workshop #2 (ISA, Kingston, Jamaica, 2017), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/2018/DSM-PRW2-Fin.pdf; accessed 30 April 2019; International Seabed Authority, Deep Seabed Mining Payment Regime Workshop #3 (ISA, Kingston, Jamaica, 2017), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Regs/DraftExpl/DSM-PRW-3.pdf; accessed 30 April 2019; D Squires et al., Deep Seabed Mining Payment Regime Workshop, Conference Report 17–18 May 2016 (Scripps Institution of Oceanography, La Jolla, CA, 2016), available at https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/Pubs/2016/DSM-ConfRep.pdf; accessed 30 April 2019; K Van Nijen, S Van Passel and D Squires, 'A Stochastic Techno-Economic Assessment of Seabed Mining of Polymetallic Nodules in the Clarion Clipperton Fracture Zone' (2018) 95 *Marine Policy* 133–141; World Economic Forum, Toward Transparency and Best Practices for Deep Seabed Mining: An Initial Multi-stakeholder Dialogue (WEF, Bellagio, 2016), available at http://www3.weforum.org/docs/WEF_Toward_Transparency_Best_Practices_Deep_Seabed_Mining_Bellagio_report_2016.pdf; accessed 30 April 2019.

price volatility all come together to create considerable risk and uncertainty and the need for predictability, notably in the financial framework.

Economic and Financial Principles

The resources of the deep seabed in the Area covered by the proposed financial regime are minerals, defined by law as all solid, liquid or gaseous mineral resources *in situ* in the Area at or beneath the seabed, including polymetallic nodules. DSM converts these mineral resources, which are an exhaustible or non-renewable natural resource, into financial assets that can then be invested to generate other economic benefits, including other assets such as the creation of 'human capital' through investment in education and skills transfer. DSM in the Area is an activity that must, under the LOSC, be carried out for the benefit of mankind as a whole. The 'benefit of mankind' is undefined and may include monetary and non-monetary benefits. The LOSC specifically states that the 'financial and other economic benefits' from DSM must be equitably shared on a non-discriminatory basis.

A financial regime for DSM has two components. The first, a payment regime, initially obtains part of the financial returns from DSM contractors (which can include States) in return for the extraction of deep-sea minerals in the Area. The second component is a mechanism for distributing – on the basis of equitable sharing – the financial and other economic benefits, which include revenue collected by the ISA from contractors under the payment regime. Different payment regimes create stronger or weaker incentives for economic efficiency, stronger or weaker conditions of risk and uncertainty, and varying levels of contractor and ISA costs. Ideally, the payment regime creates neutrality, so that the selected charges that serve as revenue-raising instruments cause the least possible distortion of the mining entity's economic decisions. A non-neutral charge that affects actions taken by such entities is distortionary, giving rise to different incentives regarding research and development (e.g., of technology), exploration, rate of extraction, time of closure, over- or under-exploitation and method of extraction. Different revenue-raising instruments also allocate risks differently among contractors, the ISA, and States. A potential trade-off exists between creating incentives and the appropriate allocation of risk. Economic efficiency requires that those best able to bear risk should absorb the risk. As risk raises costs, the payment regime should consider the risk to contractors, States, and the ISA and seek to create a stable and predictable environment, including a stable payment regime (thereby contributing to solving what is called the time inconsistency problem). On the other hand, building flexibility into the payment regime – through rules, procedures, periodic reviews and

other means – facilitates adaptation to changes in markets, technology, industry composition and structure, profitability, and other conditions.

Transparency, critical for the payment regime, leads to concerns over transfer pricing (prices at which an enterprise internally transfers goods and services that can vary according to location or situation) and arm's-length pricing (buyers and sellers of a product act independently and have no relationship to each other). Ease and low cost of administration are other fundamental principles (also required by the LOSC). Contractors and the ISA hold different amounts of information (i.e., asymmetric information), and obtaining sufficiently comprehensive information on costs and other sensitive financial information may or may not be feasible. Ideally, the payment regime is driven by the optimum structure and information needs, and the regime is crafted accordingly. Should such information, such as reliable and representative costs, not be obtainable, the regime must be adjusted accordingly. The potential absence of cost information and absence of an international tax and accounting code and tax treaties with the ISA all limit the possibilities of achieving an ideal payment regime.

Payments to the ISA should be levied as close as possible to the point of extraction, i.e., ideally either the point of loading on board the mining vessel, or first offloading of the ore, or the point of first third-party sale; this is an issue requiring further attention. The payment regime should reflect the mineral content of the ore and take account of the price and revenue volatility. Ores that have intrinsic value but that do not have market prices can be accounted for by a slightly (and perhaps subjectively) higher payment regime rate. When levied at the point when the ore is transferred from the mining vessel to a transport vessel (i.e., mine gate), the mineral content should be subject to reconciliation in port. Revenue-raising charges are ideally levied at the project level, so that accounts from the project are not mixed with accounts for activities outside of the project. The LOSC specifies that the administrative expenses of ISA are to be a first call upon revenue raised from the Area.

Risk and Uncertainty

Several issues arise related to risk and uncertainty. First, which party bears the risks of DSM and the timing of these risks? Contractors and investors bear the principal risks and face a long investment period prior to production, as discussed above. They prefer to first receive full cost recovery before paying royalties, although they recognise that payment of certain fixed fees to the ISA is mandatory. Such an approach shifts some of the payment risk onto the resource beneficiary – or, as in the case of the ISA – the resource administrator.

From the perspective of the resource beneficiary/administrator, mining costs may not be an issue of immediate concern, cost recovery may come later, and delaying payment lowers the net present value of the payment receipt stream unless otherwise specifically compensated for by a higher royalty rate. How to determine and value the mining entity breakeven (i.e., cost recovery) point and when it occurs also influence who bears the risk. In short, different emphases shift the risk to either the resource beneficiary/administrator or the mining entity.

Second, the riskier the project, the higher the hurdle rate for the DSM contractors' internal rate of return, i.e., the greater the rate of return that is required to compensate for the higher risk. Lower mining entity and investor risk can be obtained through assured payback before royalties are paid. Countries as DSM resource beneficiaries also have opportunity costs if they must wait to receive DSM-related benefits, including potentially higher borrowing and capital costs if they must finance their budgets by some other means or if delayed benefits lower current investment and future economic growth.

Third, do the same risks apply to later investors as they do to early investors? Early technology developers face higher risks from unknown technology, higher costs of technology development, an absence of proven commercial viability, and higher capital costs. Early innovators also face disincentives to fully develop the new technology, because they may not receive the full benefits of such development, and later industry entrants may not pay the full costs of employing such technology (i.e., there is the potential for free riding by later entrants). Later investors may also face lower risks and hence lower costs of capital. Later entrants, however, may also face barriers to entry. How to allocate risks and compensation between early and later entrants and its impact on resource payments to the resource beneficiary/administrator remain unresolved issues but are recognised as important. Moreover, developing countries in particular may face barriers to entry along several additional dimensions as later entrants into the industry.

Other related issues arise as well. One is the proper allocation of environmental, social, and financial risk among the ISA as an institutional body, its individual member State governments, and contractors. Another is the progressivity of a payment regime, i.e., the extent to which revenue increases as the price of the mineral rises or production costs fall. This affects the sharing of risk between the three entities. Finally, in contrast to land-based mining, where the primary risk is the scale of the resource, the primary risk for DSM is the availability of commercially proven seabed-to-surface extraction technology.

Financing

Investors ask the following questions when considering whether to invest in a project: how much is needed; what is the risk; what is the return; and when can the project be exited? Investors use tools such as the weighted average cost of capital (WACC), internal rate of return (IRR), and net present value (NPV), and also consider other risk factors (e.g., technology and market maturity) around financing DSM activities. Financing differs between the pre-feasibility, feasibility, and construction phases of development. Investors require much higher rates of return on the earlier phases, when risk is higher. For example, an investor might want 20–40 times their investment in the pre-feasibility phases versus 10–20 times their investment in the feasibility phase. The financing costs for the pre-feasibility, feasibility, and construction phases should be taken into account in financial modelling. Financing costs and considerations differ between State contractors and their subcontractors. In some instances, a State government will sponsor initial research that would typically occur in the pre-feasibility stage. Those data and research will then be given to private sector companies to use in their activities. DSM often does not fit within existing investor portfolios as risk is difficult to measure, particularly due to absence of clear regulations and uncertainty about end-to-end collection and processing technology.

Inter-generational Equity

Inter-generational equity is an inherent concern with an exhaustible resource and reflects the need to balance current with future consumption. Extraction by current generations comes at the expense of extraction by future generations. Future generations can only exercise their rights and associated claim to the benefits from extraction through provisions made by the current generation to either leave an equitable share of the resource *in situ* for future generations to extract or to save and invest some of the royalties from current extraction to provide increased consumption for future generations. The welfare of future generations is contemporaneously considered with that of the current generation. Reducing current consumption to save and invest preserves opportunities for higher consumption by, and hence contributes to enhancing welfare of, future generations.

There are two components to achieving this inter-generational equity. One is the optimum rate of exhaustible resource extraction, where the social discount rate used to assess the net present value of resource royalties over time incorporates the interests of future generations. These interests of future generations include benefits enjoyed through managing and enjoying the environment as well as net revenues from DSM. (The social discount rate captures

the preferences of society for current *versus* future consumption in this assessment.) The second component balances current consumption *versus* future consumption of the realised resource royalties through current saving and investment to achieve higher consumption in the future. (Ideally these two components would be simultaneously considered, but in practice they are separated.) With economic growth, it is expected that higher incomes, consumption, and welfare in the future can lead to further demand for these metals and hence further consumption. These considerations also come into play in deciding how to equitably share the financial and other economic benefits derived from DSM.

Mineral Prices

Metals, notably nickel, cobalt, copper, and manganese in the present case, are commodities: goods that are unbranded and easily traded. Producers are price takers with little or no control over the prices of these commodities. They will generally produce until market prices are below short-run marginal cost. Hence, competitive position is a function of production costs. DSM cost of production needs to be judged against land-based mining for DSM to be competitive. Although this is not simple for a polymetallic operation, compared to single-mineral miners, DSM may be in the lowest quartile of nickel or copper cost curves due to its polymetallic nature. Given the long lead times for mine development relative to the physical supply chain and consumption changes, metal prices tend to be cyclical. As the price for metals increases or decreases, the quantity of the resource on the market also increases or decreases, but on a time-lagged basis. The London Metal Exchange prices can benchmark the price for nickel, copper, and cobalt. This is market convention and reflects the most liquid traded market for the commodities. Adjustments to the benchmark prices might include quality, location, and/or the time period of delivery. Prices for metals tend to be 'mean reverting'. As prices increase, metal production and supply also increase, driving prices back down to the mean. Mean prices typically give a reasonable return on capital to the industry. Major metals markets should be able to absorb the entry of copper, nickel, and cobalt from DSM with minimal or no price impact. The manganese market, however, is shallow (low activity compared to the volume), non-transparent and fragmented. Depending on the manganese product, its impact on the market from DSM is uncertain and requires further analysis.

Mineral Price Volatility

The prices of natural resources are inherently cyclical and volatile. Price swings can be large and long lasting, creating a commodity price cycle. Volatility in

revenue from natural resources can also stem from sudden changes in volumes of production. The procyclicality of payments to the ISA can potentially lead to procyclicality of disbursements to States, which in turn can potentially contribute to macroeconomic volatility – higher spending associated with higher revenue. Such procyclicality can also affect ISA budgets and spending plans. The volatility of resource prices should make authorities cautious when choosing between investment in physical or financial assets, because physical assets cannot be readily unwound and at low cost to address sudden drops in resource revenue. Establishing institutional mechanisms and rules to reduce the adverse effects of volatile prices can be important.

Because it leads to revenue volatility, price volatility may potentially complicate ISA financial planning and payment disbursements, and may require the adoption of certain medium-term financial rules and precautionary savings to limit procyclicality (by delinking expenditures from resource revenues). Market-based instruments might also be used to manage price volatility.

Revenue volatility creates an incentive to save some of the revenue for precautionary reasons. A liquidity fund built up during periods of high prices and revenues can be tapped to smooth consumption spending when resource inflows fall short. The optimal size of such a liquidity buffer would be larger when revenue volatility is high and more persistent; it would also depend upon the ISA's tolerance for consumption swings. The optimal buffer would also be larger when consumption out of resource revenue is higher. Such concerns can be applied to the ISA's own budget, to the extent that it is financed by the DSM payment regime, and to payments disbursed to States.

A related issue pertains to ISA payments that sustain a constant flow of funds to States equal to the (implicit) return on the present value of future royalty revenue, modified by consideration for investment, inter-generational equity, uncertainty over reserves, credit constraints, and other factors. Once extraction is in full swing, much of the royalties can be saved to build up the stock of non-resource assets to provide sustainable benefits in the future (through, e.g., a natural resource wealth fund and investment in education). The return on these assets can sustain the spending annuity even after extraction has ended. In addition, it can smooth out spending when prices and production change. Sovereign wealth (natural resource) funds are one vehicle to limit the impact of procyclicality and achieve the ISA's required equitable sharing of the benefits. This approach takes account of the exhaustibility of the resource and the desire to maintain the value of the asset for future generations (to assist in achieving inter-generational equity).

Sustainable Development

The exhaustibility of minerals and transforming natural resource wealth into productive human, physical, and financial assets to yield sustainable economic growth and development were recognised as important topics and were noted for future consideration. Sustainable development with exhaustible mineral resources requires transforming exhaustible natural capital into sustainable financial, human, and physical capital that underpins sustainable economic growth and revenues. This transformation is complicated by the volatility of mineral prices, which is often associated with procyclicality and exposure of the economy to boom-bust cycles. Sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs plus takes into account the capacity of the natural environment to sustain indefinitely the quality of ecosystem functions and services, biological diversity, and ecological integrity. Many variations of this concept exist.

Exhaustibility of minerals presents a challenge to transforming depleting wealth into a portfolio of other assets to support sustainable economic growth and development. Resource exhaustibility gives rise to inter-temporal decisions about how much of the resource wealth to consume now and how much to save (and invest), with implications for inter-generational equity and long-term financial/fiscal and external sustainability. Revenue volatility calls for distinct medium-term financial/fiscal rules and precautionary savings. Consumption later entails lowering current consumption to save and invest in the domestic economy (unless there is a natural resource wealth fund that invests both domestically and internationally) to generate economic growth and subsequent higher rates of future consumption. This issue affects both the ISA and its equitable sharing responsibility when payment receipts originate from the Area and developing countries when payment receipts originate from their – as regards the ISA – outer continental shelves.

Different Goals for Different Stakeholders

The financial and non-financial goals and related risk mitigation of a payment regime vary for each of the key stakeholders, who may broadly be defined as States, the ISA, and companies. Goals for States, both within the Area and in national jurisdictions, may include raising revenue, diversification of their economy, skills transfer, scientific knowledge, and environmental protection. Goals for the ISA within the Area may include effectively managing operations, raising revenue for its member States that allocates rents 'fairly' between contractors and States collectively as resource beneficiaries, and administrative

ease and minimising cost, as well as to attract investment and technology to the exploration and exploitation of the Area. The ISA's environmental goals include minimising adverse impacts to the extent practicable, and more broadly, the effective protection of the marine environment.[4] Goals for companies can include profits, minimising their risk profiles (that can vary between privately and publicly owned companies), administrative ease and minimising cost, and enhancing predictability and transparency, including obtaining a social license to operate.

Findings

Fixed Fees Paid to the ISA

Annual fixed fees paid to the ISA potentially contain two fees for ISA cost recovery: (1) a regulatory fee (administrative) pertaining to exploitation contracts that starts with the signing of the exploitation contract and (2) another regulatory fee (minimum annual payment regardless of any production) starting from the date of commercial production. Over time, these fixed fees would reduce or replace assessed contributions from member States which currently support ISA administrative costs. It is not intended, however, that early industry entrants would bear all of ISA's costs. Higher ISA costs are expected under commercial production compared to the exploration phase.

Several questions arise. The size of the fixed fees and the basis for the size of the fee remain unresolved. Should fixed fees that commence once production begins be specified as a fixed fee per company, per mine, per area under contract, or per area mined? Fixed fees do not create perverse incentives to produce in order just to produce, because the same amount is paid regardless of the production level. Production just to produce in turn creates economic inefficiency. Area-based fees are commonly applied in the petroleum and natural gas industries. Fixed fees specified on an area basis can be interpreted as an access fee.

The fixed fees contribute to cost recovery for the ISA, which, in principle, can be differentiated between the ISA's function as the resource administrator (or its agent/trustee) and the regulator. A large proportion of the annual fixed fees can be attributed to ISA administrative costs. That proportion of ISA costs from managing and distributing royalties can conceptually be attributed

4 United Nations Convention on the Law of the Sea (n 1).

to resource administration and regulation. These costs can in principle be deducted from gross royalty receipts prior to disbursement.

A fixed fee can also be interpreted as comprising both an administrative fee and a fee to incentivise contractors to produce rather than not mine an area and instead speculate. That is, a fixed fee can be interpreted as containing a retention fee to counter speculation. With speculation, the ISA foregoes payments due to delayed mining, and the net present value of these payments is lower due to discounting. The ISA thus bears a cost due to time discounting. The retention fee is not a royalty. The retention fee is also part of the option value that a speculating entity is willing to pay to claim but not produce from an area. The fixed fee, as an annual lump sum, incentivises production, but because it does not vary with production levels, only incentives production that could be at a minimum prescribed level (i.e., it does not incentivise marginal behaviour). A view was also expressed that the fixed fee, along with part of the royalty, could be used for exploration, protecting mineral resources, subsidising the immature mining industry, and protecting the environment (discussed in greater depth below).

Production could be delayed for very sound economic reasons, such as to benefit from higher prices (either due to the commodity price cycle or if the mining volume can directly affect prices) and/or lower costs and to enjoy improved technology in the future. Delayed production could simply be due to forecasts about future conditions that differ from those made by other contractors or the ISA. Retention payments can then be viewed as sharing the profit from delaying and could even raise payments to the ISA compared to not waiting. Potential speculation must also be distinguished from economically optimal sequential mining of multiple sites given fixed budgets for exploitation, expectations over improved technology, the current state of the commodity price cycle and future demand, production costs, and concern over impacts on mine gate prices from large volumes of production. 'Use it or lose it' stipulations might then generate perverse incentives to produce in, at or with, respectively, economically inefficient volumes, times, and even techniques.

As an alternative to a fixed fee viewed as a retention fee, the ISA could terminate a contract or refuse a contract extension to contractors with an area contract that is not producing. The mining entity can also approach the ISA's Legal and Technical Commission (LTC) to adjust its mining plan if a period of inactivity is anticipated.

Type of Revenue-raising Charges

The major types of revenue-raising charges that are available include: (1) unit-based (specific) royalties when the charge base is a physical unit (volume or weight); (2) *ad valorem* royalties based on the value (revenue) of production; (3) profit-based royalty or business income tax; (4) economic (resource) rent; and (5) hybrid systems combining a profit- or rent-based system with an *ad valorem* system, for example. Other approaches include production sharing, joint ventures, fixed fees, auctions, and pure service agreements. The 1994 Implementing Agreement for LOSC Part XI[5] emphasises that the payment regime should not be complicated. The wording of the provision in item c, para. 1, section 8, annex of the 1994 Agreement is as follows:

> Consideration should be given to the adoption of a royalty system or a combination of a royalty and profit-sharing system. If alternative systems are decided upon, the contractor has the right to choose the system applicable to its contract. Any subsequent change in choice between alternative systems, however, shall be made by agreement between the Authority and the contractor.

Unit-based royalties are a fixed amount of money paid for each tonne of mineral that is produced. Sliding scales are common with this type of royalty and are generally set based on production levels. (Rather than being uniform for all sales, the royalty rate of sliding-scale unit-based royalties varies according to the volume of material sold.) Unit-based royalties are easy to compute, collect, monitor and provide a royalty as long as a mine operates. They are transparent and easy to administer. They are not based on the ability to pay, do not prolong payback, do not respond to market conditions, and can affect decisions to mine or continue mining. They are the least economically efficient but administratively simplest of all types of payments. Unit-based royalties, when used, are most widely used for low-value bulk commodities if distorting effects are compensated by very low compliance costs. In order for a unit-based royalty to be implemented, stakeholders need to agree beforehand on a fixed cost per tonne of mineral that will be produced, consequently reducing investor uncertainty and increasing predictability and transparency that enable contractors to further develop the DSM sector.

5 Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (New York, 28 July 1994, in force 28 July 1996) 1836 *UNTS* 3.

Profit-based royalties received considerable discussion. Profit-based payment was discussed as a potential successor to an initial payment regime, as well as an initial basis of payment. Such an approach was seen as having numerous advantages and to be attractive in an ideal setting. The approach, however, received mixed support, except perhaps after the industry matures, due to its difficulty in implementation. Specific implementation issues arising with profit-based payment include: (1) the absence of an international and common tax and cost accounting code (e.g., different capital recovery rules, allocation of common and fixed costs); (2) basis upon which to value costs, i.e., historical book value, current value of the costs (opportunity costs from current markets), methods to address depreciation of equipment, sunk costs, etc.; (3) compatibility of profit-based payment with corporate tax and other domestic obligations; (4) domestic country deductions for determining taxable income; (5) highly limited cost information available on a recurring timely basis with questionable reliability; (6) capability of the ISA for monitoring and auditing that can leave such payments open to dispute; (7) absence of an accepted process to mediate and enforce disputes over costs and profits; (8) costs, valuations, and behavioural objectives that may or may not be profit-maximising with State or State-owned mining companies *versus* privately owned ones. State (-owned) enterprises are not necessarily driven by commercial requirements. Because they do not need to yield a profit, they can operate for strategic purposes, such as operating at a loss to secure supply of valuable metals; and (9) ring-fencing projects, costs, and profit-sharing payments when companies are global and/or state-owned and/or have multiple areas under contract.

Discussions noted that cost data are available from the annual report and the audited expenditure submitted to the ISA by the contractors, which are all based on the Internationally Accepted Accounting Standards. Discussions observed that real costs of operations and capital should be distinguished from financial costs, such as interest payments. Sources for obtaining contractor mining costs might include: ISA recommendations wherein rules for allowable cost are set out or through costs reported by contractors for income tax payments to their sponsoring States.

One approach to addressing the current limitations to the profit-based payments regime sets an explicit expiration date (sunset clause) for the initial payment regime. Upon reaching the expiration date, a profit-based royalty is reevaluated. In the interim, the ISA can develop the requisite infrastructure, or the template for such an infrastructure, that addresses the current limitations to a profit-based payment program. After the reevaluation of a profit-based payment regime, such a regime can be initiated, or the initial regime

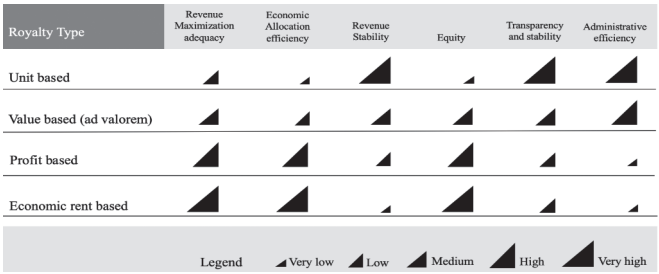
continued, with or without modifications. An explicit expiration date for the initial regime and an *a priori* established procedure for reevaluation of profit-based payment give a stable payment regime of a known and set duration for the DSM contractors and States receiving revenues over this time period.

Economic rent-based royalties are considered ideal theoretically from the broad perspective of society, because they are neutral (non-distortionary) and the resource beneficiary receives the resource rent after the mining company has received its normal profit. However, they received little support for the same reasons as profit-based payment (although the latter retains strong support for either the initial period or later periods). Additional limitations include that they are even more notoriously difficult to measure and implement due to defining and accurately measuring the opportunity cost of a normal profit. Moreover, contractors may not favour such economic rent-based charges because these charges potentially capture part or all of the 'super normal' profits that contractors seek to make in light of their risk profile and capital investment. As a result, due to the asymmetric information held between contractors and the ISA, incentives are created for weakened compliance and for providing the requisite cost information required to estimate economic rent-based charges. In conclusion, economic rent-based charges remain the ideal, but their consideration is currently premature, and the topic might best be revisited in the future.

The discussion settled upon *ad valorem* royalties as the initial royalty payment system preferred by many but not all participants in the various workshops. Discussions focused upon a transitional *ad valorem* royalty, which would (initially) start 'light' and transition to 'full'. After a certain time (to be defined), the prospect of a 'light' rate would disappear, as the purpose is to attract investment in the Area and to internalise the 'technology spill-over effects' of the first movers. Opinions differed as to the start of a transition from a 'light' to 'full' *ad valorem* royalty. Some participants retained a preference for profit-based royalties from the beginning of commercial production.

Unit-based royalties were not favoured by any workshop participants. From the perspective of the resource beneficiary, which must also consider the benefit of mankind principle, a unit-based royalty may not fully provide the benefits contemplated in the context of this principle. Unit-based royalties forsake the revenue gains from the commodity price cycle. *Ad valorem* royalties are more economically efficient and less distortionary in terms of investment and operations than unit-based royalties. *Ad valorem* royalties are also more administratively difficult and costly than unit-based royalties. Like unit-based royalties, *ad valorem* royalties are payable regardless of whether the mine is making a profit or loss. Unlike unit-based royalties, however, *ad valorem*

TABLE 2 Qualitative assessment of the performance of various royalty types with regard to the main governance objectives, adapted from Guj (2012)[6]



royalties can fluctuate in unison with commodity prices. Higher prices yield more revenue than lower prices.

Consideration was given to the *ad valorem* royalty as either: (a) fixed (but adjusted for inflation) over the entire time period or (b) changing over time according to changes in an international market baseline price, such as from the London Metal Exchange. However, proponents of scenario (a) thought that a fixed *ad valorem* royalty could be subject to changes in the payment regime (i.e., time inconsistency) during periods of peak prices, and that instead predictability and risk minimisation for all parties were better served in the end by an *ad valorem* royalty that in some manner tracks the international market baseline prices.

Table 2 summarises many of the advantages and disadvantages of alternative royalty regimes.

Market Value

Market value can be defined in several ways. To satisfy concerns over transfer pricing and arm's-length pricing, the ISA can adjust a fairly standard transfer price clause to an arm's-length clause. Transfer prices are the prices at which an enterprise internally transfers physical goods and intangible property or provides services to associated enterprises. Transfer prices can be applied to inputs or outputs. In effect, the company buys and sells to itself at 'artificial' prices that are not arm's-length prices. An arm's-length price is a price comparable to that which would be determined if the buyers and sellers of a product act independently. An arm's-length price for a transaction is therefore what the price of that transaction would be on the open market.

6 P Guj, Mineral Royalties and Other Mining-Specific Taxes (Im4dc, Australia, 2012), available at http://im4dc.org/wp-content/uploads/2012a/01/UWA_1698_Paper-01_-Mineral-royalties-other-mining-specific-taxes.pdf; accessed 30 April 2019.

There was general agreement that using a 'market basket' of ores and valuing these minerals would be an appropriate method for setting royalty rates. Discussions addressed which metals to include in the basket. Options considered include: all metals in the ore; a specific number of metals in the ore, determined by abundance (e.g., the three, four, or five most common metals); and a specific number of metals in the ore, determined by value. Copper, manganese, nickel, and cobalt, the common metals in polymetallic nodules, were generally given special consideration for the core ores in the basket.

Several options were developed for methods by which to value ore. The prices used for valuing each traded ore could be some average of London Metals Exchange prices for a limited number of days just before and after the period of offloading or for longer periods, notably the six-month price. Such averaging smooths the price and reduces the price risk that follows sudden swings in the market. These prices could potentially be adjusted for differences in costs, such as transportation, handling, and insurance, to form the f.o.b. (freight on board) price at the point of valuation. Not all metals are traded on the London Metals Exchange, however. For elements without commercial value, a specific fixed price presents one possibility. Another option is to simply raise the rate by a very small amount for the major basket ores. Another option discussed was providing an incentive to recover all metals in the ore and reduce waste if economically feasible.

Several possibilities were raised for the location to value the ore. Once the ore leaves the Area, the ISA has no jurisdiction. Tracing ore to the processing plant becomes more difficult. Options for locations at which to value the ore include the point of offloading (mine gate). Sampling mineral content of offloaded ore or requiring receipts of actual payments to be sent to the ISA are possibilities. The point of first third-party sale using international benchmark prices is another possibility but does not seem feasible in the initial years of this industry. The average mineral content could be established from contractors' resource assessments of their license area over some prescribed area, where mineral content is assumed to be homogenous and constant over a large area. Such an approach means that the mineral content or grade of offloaded ore does not require further assessment or verification, for example, by sampling, at the point of off-loading.

Different formulae exist by which to measure the overall ore price that incorporate the different mineral contents, and further research on producer price indices will be required to inform the ideal price index formulae. A key issue becomes accurate measurement of the off-loaded ore's weight or volume; however, it was considered that this would be easily achievable and relatively inexpensive with modern technology. Another approach simply takes the realised

value as shown on contractors' invoices of arm's-length sales submitted with their royalty returns, although the issue is then raised of transfer pricing and appropriate assaying and payable recovery, the latter of which is particularly appropriate with polymetallic ores. Realised hedging gains or losses can be netted out of the realised value on the premise that this is the responsibility of the mining entity.

An *ad valorem* royalty, which captures changes in international market benchmark prices, leads to revenue and payment receipt procyclicality. Such procyclicality tracks both short-term price variability and the longer-term commodity price cycle. Such volatility creates upside risk to contractors at the peak of minerals prices during a cycle (for example, through particularly high royalty payments) and downside risk to the ISA and States that are recipients of the payment regime receipts at the troughs of minerals prices during a cycle (for example, through unstable revenues to finance budgets). During price troughs, contractors with narrow-margin operations can also become unprofitable and net cash flows may fall below the corresponding marginal cash operating costs, justifying mine closure. A price ceiling and a price floor, creating a corridor of admissible prices for the *ad valorem* royalty, can create a more stable and predictable royalty environment that recognises price and revenue procyclicality, establishes income floors, and minimises risks for both contractors and States. Such price bands along with royalty rates can be periodically reevaluated on a fixed schedule. The actual magnitudes of the price ceiling and floor and the frequency of their review require further attention. Within the range set by price ceilings and floors, royalty rates can be fixed or variable with a predictable way of moving and a formula for how rates adjust. A model for such an approach is variable rate mortgages in mortgage markets.

Proposal for a Hybrid ad valorem *Royalty and Fixed-fee Payment Regime*

The view was expressed that a hybrid royalty regime should start as simply as possible, given the embryonic state of the sector, high start-up costs, and considerable risk as discussed above. Today, there is no seabed mining industry, and it may take a few decades for the industry to mature and potentially prove economically viable, if it does so at all (see Fig. 1). Consideration of the above principles and discussion about fixed fees and *ad valorem* royalties lead to a potential hybrid payment regime comprised of an *ad valorem* royalty and a fixed fee, which is illustrated in Fig. 2.

Given the above, under the proposal, the hybrid payment regime begins after the exploration phase with an initial fixed fee for administrative costs, when the fixed fee increases once the mining entity's exploitation contract

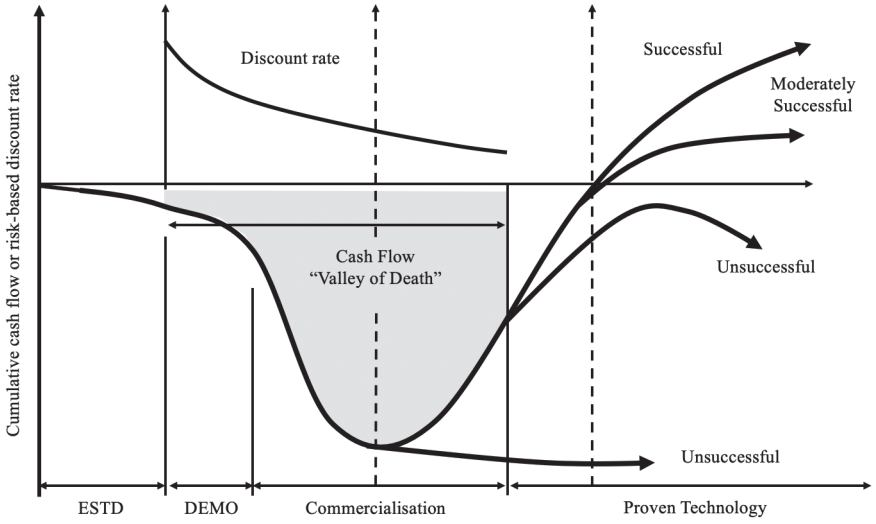


FIGURE 1 Development program for a seabed mining project

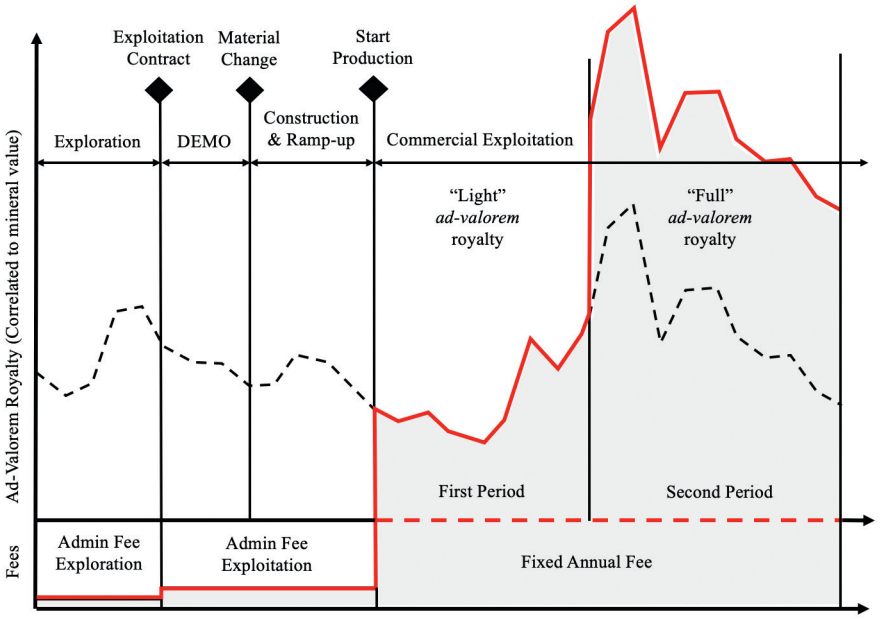


FIGURE 2 Proposal for a hybrid *ad valorem* royalty and fixed-fee payment system

has been awarded and the major investment phase begins. When commercial production begins, and mining revenues start, an additional fixed fee is paid that remains constant over some time period, such as 20 years. Furthermore, with the commencement of commercial production, an initial or interim *ad valorem* royalty is paid that recognises payment to the resource administrator/beneficiary and that contractors have yet to break even (i.e., costs are not fully recovered and profits are negative). Once the break-even point is reached, the *ad valorem* royalty rate increases to the full *ad valorem* royalty rate to allow the (by now) positive profits to be shared between the mining entity and the resource beneficiary and further discharge the latter's legal responsibility of ensuring that DSM is carried out for the benefit of mankind as a whole.

The royalty rate can be capped between a price ceiling and a price floor to limit revenue procyclicality, establish a floor to ISA and State revenues, and to bound associated risks, although this option received little support from workshop participants. The royalty rate can either be fixed or can be variable, tracking some agreed financial benchmark. The tracked benchmark could include cumulative or daily production (at the risk of no profit with production), spot prices, an average over some defined period, or even a moving average international benchmark price (discussed below). Variable interest rate mortgages provide the model for such a variable *ad valorem* royalty rate payment regime.

Additional Issues

Ad valorem *Royalty*

As discussed in Bellagio, another valuation issue arises regarding the choice of currency to value the revenues and fluctuations in these exchange rates, which creates another source of risk to all parties. Some consideration was given to International Monetary Fund (IMF) Special Drawing Rights (SDRs), which is a basket of reserve currencies, but the standard practice of using U.S. dollars was recommended.

The setting of the actual *ad valorem* royalty rate requires additional attention. Section 8 (Financial Terms of Contracts) of the LOSC Implementing Agreement stipulates that rates of payments to the Authority shall be within the range of those prevailing in land-based mining of the same or similar minerals to avoid conferring on deep seabed contractors an artificial competitive advantage or imposing on them a competitive disadvantage. However, this is not straightforward, given that land-based rates, and basis for calculation,

vary substantially and ISA will need to set a royalty that is appropriate to the resource and business model, taking into account the various factors set out above.

The size of the *ad valorem* royalty rate requires further discussion and has several implications. A lower royalty rate starting from the beginning of commercial production (discussed below) – a lower or 'light' royalty rate – can incentivise entry into the industry, because, as discussed below, it provides an implicit subsidy under certain conditions. This implicit subsidy can be either 'good' or 'bad' in ways discussed below. Moreover, maximum production is typically realised only after lower production in earlier years, which gives limited profits during this time period. The size of the royalty rate also has implications for risk bearing and risk tolerance by producers and the resource beneficiary. As discussed above, a 'light' royalty rate during early periods of production lowers risk to contractors and shifts risk onto the ISA and, eventually, the beneficiaries who, pursuant to the LOSC, are to receive a share of the financial and other economic benefits derived from DSM. A 'light' initial royalty rate can incentivise faster production rates in the early years, because the royalty as a cost to producers falls. Higher earlier production may or may not affect the optimal rate of exploitation over the entire time period of the resource that maximises expected net present value, depending upon size of rates, size and quality of the resource, risk tolerances, impacts upon industry entry, option value of waiting to produce, exploration, development of new technology, minerals prices, input prices, and other factors. Certainly, a relatively higher initial rate for a limited exhaustible resource stock, all other factors held constant, leads to faster exhaustion of the resource and hence earlier closure of the mine.

The question remains unanswered of when and how to measure the movement from the interim or 'light' *ad valorem* royalty rate to the 'full' *ad valorem* royalty rate. The point at which the payment regime switches from 'light' to 'full', depending upon the length of the interim time period and how quickly the regime transitions, can create differential incentives for the development and diffusion of new technology. Similarly, the royalty rates in both the 'light' and 'full' payment regimes and any legal instruments that may be imposed have different impacts upon the development and diffusion of new technology.

In effect, the 'light' regime can potentially create a 'good' subsidy for the first years to incentivise entry and innovation. A 'good' subsidy recognises that early entrants bear higher costs and risk and that the innovator does not receive the full benefit of innovation while nevertheless bearing the full costs and risks of innovation. There are external benefits to the innovator, creating an incentive to underprovide new technology and to free riding by others.

As discussed previously, early entrants into the industry (first movers) face higher risks and costs than later entrants, and one intent of the payment regime is to create economic incentives for contractors to enter the industry and to start production (rather than simply 'sitting' on their site and not producing at all or not producing at the full rate). The question that arises with the 'light' *versus* 'normal' royalty period is whether this equally or differentially extends to all contractors regardless of when they enter the industry. The LOSC confers no special advantage once a mining entity enters the industry, i.e., treatment is equal, and the principle is nondiscrimination. Hence, the same incentives and regulations apply to all contractors, regardless of whether they are early or late entrants.

Limits to defining the 'light' regime by years, as opposed to another criterion, were noted. Defining the 'light' regime by years could potentially incentivise a 'race to extract', because contractors will pay a lower rate on a higher volume of production and also benefit from a higher net present value by receiving revenues earlier rather than later. Such an extraction rate differs from the socially optimal rate of extraction and creates economic inefficiency. Again, the difference in discount rates (time value of money) to contractors and the resource beneficiary also affects the socially optimal rate of extraction. An alternative to a fixed time period for the 'light' royalty regime, during which the implicit subsidy for early industry entrants is maintained, is to define the switching point from 'light' to 'normal' as production levels or cumulative production levels are reached that achieve economies of scale in production.

Measuring mining entity break-even costs, at which full cost recovery occurs, can be difficult. Complicating factors include obtaining and measuring costs, auditing, dispute settlement and enforcement, and other factors discussed above. Measuring mining entity break-even points is also subject to the problem of moral hazard when the mining entity and ISA have different or asymmetric information. Asymmetric information arises exists when the risk-taking party to the transaction, here the mining entity, knows more about its intentions and its costs than the party bearing the consequences of the risk, here the ISA representing the resource beneficiary. Moral hazard can occur when the actions of the party with more information about its actions or intentions has an incentive to change those actions to the detriment of another party with less information after a financial transaction has taken place or after a contract has been written and implemented. For example, some contractors may face an incentive to inflate or otherwise alter their costs to prolong the perceived time until achieving the break-even point. One approach (to mitigate the problem of defining and measuring break-even) suggested was to define the break-even point, at which the *ad valorem* royalty regime

switched from 'light' to 'normal', as a fixed and *a priori* agreed number of years. This approach balances the trade-off between the resource beneficiary receiving financial and other economic benefits derived from, e.g., royalties earlier with a higher net present value and contractors lowering risks and increasing profits by delaying the time when normal royalties become payable. Ring-fencing costs to a mining site or license area becomes important when determining what is an allowable cost when providing for break-even costs or a profit-sharing payment regime.

The resource beneficiary and contractors may also vary in their discount rates (due, for example, to different rates of pure time preference), which in turn affects the date of switching from light to full royalty payment. As a general rule, private parties (both firms and consumers) have a higher discount rate than society, which can also be compounded by different levels of risk.

Not fully discussed and requiring further attention is the basis of the size of the annual fixed fee and how it relates to the *ad valorem* royalty and any potential user charge for cost recovery within the (domestic) fiscal regime. The relationship between the ISA payment regime and contractors' home State tax codes, tax credits, and other such issues may also require further attention.

The issue of how to define progressivity also arose. Progressivity could be defined in terms of revenue, thereby in accordance with an *ad valorem* royalty regime, rather than profit. A profit-based royalty regime may lend itself better to progressivity than an *ad valorem* royalty, but as noted the profit-based royalty was deemed inoperable on a practical basis, at least in the foreseeable future. The gains in technology – that lower cost and boost profits and may or may not affect revenues – derive from the activities of contractors but are potentially shared between the mining entity and the resource beneficiary. (The impact on revenues and profits in part depends upon the responsiveness of mineral prices to changes in volumes and any impact upon volumes of production.)

How should the date of first commercial production be defined? The definition of this date can have several implications. The definition affects the date at which the 'light' *ad valorem* royalty commences. The definition can also create incentives for alternative mining entity actions and for smoothing out and lowering risks. For example, pilot projects generate ore that can be sold. Should this pilot production and/or lower initial production-building experience and learning by doing prior to full production count toward commercial production, or can it be considered as part of the development phase that lowers producer risk and costs? Counting pilot production as commercial production could then delay the pilot phase of development, potentially raising producer risk and costs, delaying larger-scale production, and lower the net present value of the *ad valorem* payments (due to time discounting in which

payments received at a later date are valued lower due to the time value of money). Conversely, such an approach can lead to moral hazard by creating incentives to deliberately maintain ostensible pilot production. Should the resource administrator, responsible for ensuring that DSM provides benefits for mankind as a whole, share in all of the revenues, even those not explicitly intended for 'commercial' production, because any input use should yield benefits for the resource administrator/beneficiary? (The general opinion at the workshop was yes, although it may not have been unanimous.) Non-payment on pilot production under some circumstances could be interpreted as an implicit subsidy to incentivise entry into the industry and earlier production by lowering production risks and costs.

A clear definition of the date of first commercial production, with no potential for manipulation or misinterpretation, was emphasised. Several options were raised. A simple definition is the first time the barge is filled up and the ore sold. Another and widely used definition is some agreed percentage of production capacity. Yet another definition raised was some level of revenue, which could be the amount sufficient to cover marginal costs or some other threshold amount.

How should commercial inactivity be defined and what are its implications? Commercial inactivity has several implications. The annual fixed fee is paid regardless. Commercial inactivity can also entail speculation, which was discussed under the 'fixed fees' heading above.

The right to audit affects compliance with and enforcement of royalty obligations and the use of cost recovery systems. Auditing ore is for mineral volume and content, the parameters on which valuation is made. Practical issues are important. Points of ore transfer along the supply chain at which minerals are valued are easier and cheaper to audit than auditing in member States. Auditing during the initial stages of the supply chain, notably transfer of ore from mining vessel to transport barge or port of (first) landing, represent natural points of valuation and auditing. Auditing higher in the supply chain must account for changes in content and value due to processing, waste, transport costs, and other factors that affect value added and mineral content.

Penalties remain an unresolved issue with multiple facets. For example, what type of penalty and interest payments apply to delayed payment? The IMF's SDR interest rate could be applied to late payments. Another example is an escalation procedure that ultimately could lead to contract termination when payments are not made.

Review of the payment mechanism was discussed. The LOSC provides for the possibility of review of mechanisms as conditions change and experience is gained with the phased approach in the payment regime and the need to

create an incentive for early entrants and investors, other elements of the payment regime and with DSM as an activity. After a review, for example, the royalty rate might be adjusted as experience is gained, or an *ad valorem* royalty regime might transition to a profit-based regime, or the type and length of any incentives for early entrants might change. The review can be on both a periodic and a regular basis. The discussion also included whether or not contractors should also be reviewed on a periodic and regular basis, and whether or not early entering and later entering firms should be subject to different conditions and standards, as discussed elsewhere. The discussion also considered whether guiding principles and thresholds should be set, and if reached, whether other specifications of the payment regime begin, and if so which and when. Although review is considered important, the need for a stable payment regime (time consistency) was also stressed to give contractors a predictable business environment. DSM entails several production decisions over time. Each decision can be very difficult, sometimes more so than previous ones, and each time period's previous costs are sunk costs. Predictability of the business environment is what will drive the next investment decision. New technology must also be developed with accompanying high risk, and predictability is required to contain the high risks. The importance of gaining experience over at least one and perhaps two mineral price cycles was raised innumerable times. Different systems could be implemented for consecutive contractors applying at different times. The difficulty in changing the payment regime in response to reviews was also raised in that all changes require multilateral negotiations among ISA member States. From this perspective, a stable payment regime is necessary.

Conservation, Prevention of Waste, and High-grading

The workshops briefly discussed conservation of the mined resource, prevention of waste, high-grading, and how the payment regime takes these topics into consideration. Because of their inherently difficult location on the seafloor, it is expected that: (1) it will be very difficult to achieve optimum levels of mineral recovery (from a total resource perspective) within a given deposit area and (2) dilution of the ore will be a problem in marginal areas of any deposit. Nonetheless, lower grade or more inaccessible resources can be left for future generations that may have better technology to exploit the lower grade or more inaccessible resources. Moreover, DSM differs from land-based mining in the ability to sterilise ore. DSM does not have veins or chutes and the overburden question that arises on land when sterilised, and hence the issue may be less serious than on land.

Based on available deep-sea information and experience gained from relevant land-based mineral developments, DSM can be expected to proceed sequentially from: (1) relatively small but high-grade areas with a rapid payback to (2) a limited, but significant number of large and high-grade occurrences to (3) similar-sized deposits but of relatively low grade.

High-grading is mining the highest concentration or higher valued mineral content to maximise profits and minimise costs over a short time period, but not mining, or leaving as "waste", lower grades of ore. High-grading depends upon the resource. High-grading for polymetallic nodules pertains to abundance and as such may not even exist, because mining high abundance areas does not entail 'destroying' low abundance areas. High-grading for polymetallic sulphides pertains to the quality or grade of metals of the ore and, as polymetallic sulphide deposits are heterogeneous, high-grading may happen when the contractor mines high-quality ore and in the process 'destroys' low-quality ore. However, high-grading is fundamentally an economic decision. There can be sound economic reasons for high-grading the deposit. If the operational costs of mining are very high, for example, mining only the highest-grade portions of the deposit may be the only economically feasible alternative. Economically, this can be viewed as mining a deposit with a high cut-off grade. The position in the commodity price cycle, current and expected future state of technology, depth of the ore for some resources, and other factors also influence the economic decision on the cut-off grade. What appears to be high-grading and "waste" over a longer time period may simply be the sequential mining of different areas that yield the highest net present value. Full removal of a resource is also not necessarily ecologically beneficial. With polymetallic nodules, for example, leaving some nodules in an area facilitates recovery, because this provides substrata and organisms to reseed the area. Moreover, ecosystem functions and services are also part of the benefits of the Area for mankind as a whole, not just the minerals removed and their payment stream.

High-grading has a number of implications. Starting with high-grade areas can also impart a smaller impact to the ecosystem and lowers the costs and can potentially increase the rate of learning-by-doing with new technology by starting sooner than otherwise. Starting with high-grade areas also increases the revenues in the early period, and when coupled with discounting, increase the net present value of the cash flow and thereby payments as part of the financial and other economic benefits derived from DSM. If the ISA controls enough area to affect price, then conservation becomes, in part, an economic question of controlling supply and thereby price. There are also costs to the ISA by pricing quality. Eventually, an Economic Planning Commission can monitor

supply and demand and can constrict supply to influence price and thereby payments, with the attendant consequences for the aforesaid financial and other economic benefits.

Divergent views were expressed on high-grading, but the general view was that production decisions should be left to the mining entity. Any environmental issues related to "waste" and high-grading should be addressed through environmental policy instruments rather than through the payment mechanism, which should instead address the optimal timing and grade of ore extraction.

Specification of the payment regime, along with the current status of minerals markets and state of technology, also creates differing incentives to high-grade and prevent waste. For example, the payment regime specification may affect the timing of the mine shut-off and choice of areas to mine that contain more marginal deposits. Alternatively, the payment regime might set differential royalty rates according to ore grade and even area mined, where a lower royalty rate corresponds to a lower ore grade. The payment regime could set a threshold for minimum extraction from areas with high ore abundance and quality. In contrast to land-based mining, revisiting a reserve for recovery at a later date may not be economically feasible. Some expressed the view that extraction should be of average balance grade. Incentives should also satisfy additionality, that is, incentives should only apply to activities contractors would not otherwise do.

Relinquishment clauses in mining contracts can also comprise part of the payment regime to incentivise 'whole-of-deposit' mining. Contractors would relinquish areas that they think contain insufficient ore grade, and the ISA might retender these to other contractors or set them aside for conservation. The ISA does require in exploration contracts the progressive relinquishment for all three resources that are the current focus of DSM in the Area. An unresolved issue is the exploitation contract area size and whether or not contractors are permitted to immediately mine all of their contract area or whether they must progressively mine it. In short, relinquishment exists with exploration but remains unresolved for exploitation.

Land-based Producer Compensation

Should land-based producers of the same minerals that are affected by DSM receive compensation if DSM leads to a lower price or these land-based producers are displaced from the market? The impacts of changes in relative prices on land-based mining firms, which is an example of a 'pecuniary externality', do not alter the level of aggregate economic income but merely redistribute it among the different parties involved. This redistribution does not lower

economic efficiency, but it can have important implications for aggregate social welfare if the adversely affected parties are deemed more important (i.e., have higher welfare weights) than the benefiting parties. Economic efficiency analyses attach equal weight to all parties, but when considering aggregate social welfare, developing countries with adversely affected land-based mining may receive a higher welfare weighting, in which case a decline in overall social welfare is expected. Developing country-owned DSM would similarly receive a higher welfare weight when evaluating the net benefit impacts of relative price changes.

Whether or not increased DSM mining displaces land-based production depends upon whether or not the incremental DSM production is an addition to existing production, in which case there is no displacement of existing land-based or DSM production. DSM production may displace existing land-based production due to greater economic efficiency (lower costs). DSM production may also both increase overall supply and displace existing land-based production. Even with displacement, overall net benefits increase, although there are both gainers and losers. The increase in economic benefits may also exceed the increase in accounting profit. The picture is more complicated if the higher costs incurred by a displaced producer could be due to environmental mitigation. The question of compensation arises when DSM mining displaces land-based mining.

Environmental Responsibility

The payment regime is part of a package that also includes the environmental responsibilities of contractors and the ISA. Creation of incentives cannot separate payments and environmental responsibilities. Environmental damage from seabed mining, which creates an external cost, is unlikely to receive substantive remediation, if at all, due to the nature of the resource in the deep-sea environment. (External costs are costs borne by society but not borne by producers or consumers of the final product.) Without remediation, contractors do not bear corresponding remediation costs, as they are normally expected to do on land. Environmental damage can also create liabilities that are both known and unknown. Known environmental damage can be addressed by an environmental charge that differs from the *ad valorem* royalty and should be kept distinct. The environmental charge receipts can be placed into an environmental fund (or sustainability fund) that is distinct and ring-fenced from the royalty receipts. The royalty is due to payment for exploitation of the 'publicly "owned"' (i.e., by humanity) exhaustible resource, whereas the environmental charge and fund represent payment for the environmental damage associated

with the extraction of the resource ('internalising the external cost'). These two purposes are completely distinct and should not be conflated. Unknown or unforeseen environmental damage can be addressed by an environmental liability fund or through an environmental bond (or one of self-insurance).[7]

A related issue arises with environmental impact. If DSM production is an addition to the mineral supply, then there is no environmental gain from reduced adverse land-based environmental impact. If DSM displaces land-based production, then any environmental gain from reduced adverse land-based environmental impact is weighed against the increased adverse DSM-induced environmental impact. Defining 'like-for-like' and how to compare different types of environmental impacts pose considerable difficulty.

Conclusion

Several general issues and principles were discussed in the various workshops regarding the design and implementation of the DSM payment regime. First, the early years of a financial regime should aim for stability, certainty, and predictability (time consistency). The workshops identified a possible transitional approach that includes economic incentives to attract investment, low-cost administration, and administrative costs plus a fixed fee. The discussion recognised that the payment regime should facilitate stability in the initial years when contractor risks and costs are high, and production and revenues are low or non-existent. Creating economic incentives for entry into the industry and investment is critical to achieve this economic growth in the context of sustainable development. The view was expressed that the royalty regime should start as simply as possible, given the embryonic state of the sector, and to avoid administrative complexity and cost. DSM, as a nascent industry with an evolving institutional structure, entails considerable risk and uncertainty. Second, the discussion identified as the preferred payment mechanism an *ad valorem* royalty approach (that increases over time) and left open the possibility of alternative approaches, such as profit sharing. A major concern expressed about profit sharing is the difficulty of obtaining sufficiently accurate and comprehensive cost data that are consistent across States and national tax regimes and needed to measure profit. Third, new technology must be developed for DSM to be commercially viable while also minimising adverse environmental impacts. Incentives to fully develop new technology are not sufficient unless

7 Lodge, Segerson and Squires (n 3).

the innovator enjoys much of the benefits of the new technology. New technology is typically underprovided, because the innovator pays for the technology but does not receive the full benefits, whereas other parties can utilise the new technology without paying for it. Finally, all these elements contribute to designing a payments regime that achieves the LOSC's requirement that DSM must be carried out for the benefit of mankind as a whole.