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SPACE EXPLORATION THROUGH SELF-REPLICATION TECHNOLOGY COMPENSATES FOR DISCOUNTING IN NPV COST-BENEFIT ANALYSIS – A BUSINESS CASE?

Abstract

Self-replication technology is a little known technology that is currently under development which has enormous implications for affordable space exploration. In particular, the prospect of 3D printing of actuators and electronics offers the prospect of realising a universal constructor, the basis of a self-replicating machine. The universal constructor is a general-purpose automated factory supported by a number of robotic devices. If programmed appropriately, it can manufacture a copy of itself (as well as other products). We present an overview of self-replication research and its application to colonisation of the Moon at very low cost – it offers a means to overcome the high cost of launch through exponential exploitation of in-situ resources. Combined with in-situ resource utilisation, a universal constructor can construct (in theory) almost any product within certain constraints. Indeed, its productivity dwarfs any potential cost reductions in launch costs. We shall focus on defining several critical technological developments. It has potential commercial applications in extremely low cost manufacturing of solar power satellites for clean energy production for Earth. Self-replication capability offers a mechanism for offsetting discounting of future revenue (as computed by net present value (NPV) cost-benefit analysis) by generating exponentially increasing revenue over time. It represents a "Bold" (as advocated by Peter Diamandis) approach for a start-up company, steps towards which are being taken. These steps will be discussed in detail. However, the revolutionary economics will make it challenging to attract capital investment despite eliminating the discounting effect. Nevertheless, a business case can be made despite a long time horizon of investment due to numerous progressive spin-off applications. Over the long term, self-replication technology could revolutionise space exploration by providing for remote construction of complete (albeit simple) spacecraft in large numbers from in-situ resources. By virtue of this massive productive capacity offered by self-replication technology, missions that are currently considered too expensive or impractical become feasible, eg. space-based geoengineering, asteroid exploitation and/or mitigation, difficult outer planet locations such as Enceladus, interstellar precursor missions, etc.