



## THE March 2021 BRAIN TEASER & SOLUTION

### The Magnificent 12

#### THE MARCH BRAIN TEASER

You are the director for an exceptional business opportunity. You lead 12 magnificent teams of world class talented individuals equipped with new technologies. Your role is to allocate the 12 teams into the three functions below to maximize their extremely valuable production.

1 - Discovery Teams: perform the research and discovery function from an unlimited set of prospects. Basic discovery is 1 year with a one in six chance of success. Teams with failed prospects start over. Teams with successful prospects go through a 2-year maturation phase.

2 - Development Teams: each team takes a matured prospect and develops unique manufacturing facilities for it. Each product facility takes 3 years to develop.

3 - Production Teams: each team takes a developed facility for production, sales and marketing. Products are produced for 6 years at a fixed rate of 100 units per year, and then discontinued.

The business will last exactly 36 years, 6 for initial discovery and development and 30 production years, then decommissioned with existing production streams truncated. All teams are present the entire 36 years and can do all functions. Start them off as you deem optimal. At the end of each year you can promote teams from function 1 to 2, and/or from 2 to 3, but teams can never be demoted back. Once a team finishes their task, they circle back to the front of the queue for their respective function. Teams can be idle, but of course that is a source of inefficiency.

**Question 1.)** What is your allocation strategy for the 12 teams into the 3 functions throughout the 36 years to maximize production? Hint: Think best steady state allocation, then ramp-up and sunset phases.

**Question 2.)** Based on your above strategy, what is your estimate for mean annual production? (EV total units produced divided by the 30 production years, expressed in EV units per year)

**Hint:** Intuitive solutions using pencil, paper and calculator are perfectly acceptable. Well reasoned intuitive answers will be very close to the alternative of a mini-model using Monte Carlo.

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#### Solution

Intuitively since it takes development teams 3 years to develop each product, but production teams are engaged for 6 years to produce each product; twice as many production teams are needed relative to development teams. On the discovery side, through simple math or a mini Monte Carlo model, 12 teams can generate on average 1.50 products a year (6 teams 0.75 prod/yr) on a steady state (SS) basis.

**Question 1:** The optimum for the 12 teams across the three phases is 6 discovery teams, 2 development teams and 4 production teams on a SS basis. The starting point is 12 discovery teams with a ramp-up promotion strategy towards the above SS as products are discovered and developed. A sunset strategy promotes teams to maximize late year production.

**Question 2:** At 100 units/yr per production team, a good SS initial estimate is 400 units/yr. In reality, due to systems constraints and randomness the average is lower, like 360 units/yr SS. The ramp-up and sunset effects that further lower the 30 year production average to 350 units/yr. The ramp-up strategy plus sunset strategies maximize full life average production to 390 units/yr.