8) How to change your project network based on the number of your teams and machines?

Assumptions:

* There are 8 PC.
* There are 5 programmers.
* The project is resource constrained.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | User Specification | 2P +1M | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| B | Development Specification |  |  | 2P +1M | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| C | System Design |  |  |  |  |  | 2P +1M | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| D | Database Design |  |  |  |  |  |  |  |  |  |  | 2P +1M | | | | |  |  |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| E | Racks & server setup |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +1M | |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| F | Datacenter setup |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +1M | | |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| G | Install router & switched and connection cables |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2p+1M |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| H | Configure DNS and Gateway |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +1M | | |  | |  | |  | |  | |  | |  | |  | | |
| I | Website Database And authorization implementation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +2M | | | |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| J | Website backend Testing & Integrations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1p+1M | | | | |  | |  | |  | |  | |  | |  | |  | | |
| K | Prototype |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +2M | |  |  |  |  |  |  |  | |  | |  | |  | |  | |  | |  | | |
| L | UI/UX Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +2M | | | | | | |  | |  | |  | |  | |  | |  | |  | | |
| M | Integrate Frontend with Backend and final testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +2M | | | | | | | | | | | | | |  |
|  |  | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | | 130 | | 135 | | 140 | | 145 | | 150 | | 155 | | |

**The dependencies are shown with the vertical connecting arrows. The horizontal arrows following activities represent activity slack.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of programmers needed | 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6 | | | |  |  |  |  |  |  |  | ` |  |  |  | |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | | | |  |  |  |  |  |  |  | |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| 2 | 2 | | | | | | | | | | | | | | | | 2 | | | | | | |  |
| 1 |  |
|  | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | |

**inadequate resources**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of machines needed | 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ` |  |  |  | |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | | | |  |  |  |  |  |  |  |  |  |  |  | |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 | | | |  |  |  |  |  |  |  | |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | | | | | | |  |
| 1 | 1 | | | | | | | | | | | | | | | |  |
|  | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ID** | **RES** | **DUR** | **ES** | **LF** | **SL** | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** | **45** | **50** | **55** | **60** | **65** | **70** | **75** | **80** | **85** | **90** | **95** | **100** | **105** | **110** | **115** | **120** | **125** | **130** | **135** | **140** | **145** | **150** | **155** | **160** | **161** |
| A | **2P+1M** | **10** | **0** | **10** | **0** | 2P+1M | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B | **2P+1M** | **15** | **10** | **25** | **0** |  |  | 2P+1M | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C | **2P+1M** | **25** | **25** | **50** | **0** |  |  |  |  |  | 2P+1M | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D | **2P+1M** | **25** | **50** | **75** | **0** |  |  |  |  |  |  |  |  |  |  | 2P+1M | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E | **2P+1M** | **10** | **75** | **85** | **0** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+1M | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| F | **2P+1M** | **15** | **85** | **100** | **0** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+1M | | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| G | **2P+1M** | **5** | **~~100~~ 105** | **~~105~~ 110** | **~~0~~ -5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2+1 |  |  |  |  |  |  |  |  |  |  |  |
| H | **2P+1M** | **15** | **~~105~~ 110** | **~~120~~ 125** | **~~0~~ -5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+1M | | |  |  |  |  |  |  |  |  |
| I | **2P+2M** | **20** | **~~75~~ ~~80~~ 85** | **~~95~~ ~~100~~ 105** | **~~5~~ ~~0~~ -5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P +2M | | | |  |  |  |  |  |  |  |  |  |  |  |  |
| J | **1P+1M** | **20** | **~~95~~ ~~100~~**  **~~105~~**  **110** | **~~115~~ ~~120~~ ~~125~~ 130** | **~~5~~ ~~0~~**  **-~~5~~**  **-10** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1P+1M | | | |  |  |  |  |  |  |  |
| K | **2P+2M** | **10** | **75** | **90** | **5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+1M | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| L | **2P+2M** | **30** | **~~85~~ ~~90~~ ~~95~~ 100** | **~~115~~ ~~120~~ ~~125~~ 130** | **~~5~~ ~~0~~ -~~5~~ -10** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+2M | | | | | |  |  |  |  |  |  |  |
| M | **2P+2M** | **31** | **~~120~~**  **~~125~~**  **130** | **~~151~~ ~~156~~ 161** | **~~0~~**  **-~~5~~**  **-~~10~~** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2P+2M | | | | | | |
| **Total Programmers Load** | | | | | | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **5** | **5** | **5** | **3** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **Total Machine Load** | | | | | | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **2** | **3** | **3** | **3** | **4** | **3** | **4** | **4** | **4** | **3** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **Available Programmers** | | | | | | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** |
| **Available Machines** | | | | | | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** | **8** |

**The parallel method:**

**0 🡪5 : Only activity A is eligible. It requires 2programmers + 1 Machine. Load activity A into Schedule.**

**5 🡪10 :** **No activities are eligible to be scheduled.**

**10 🡪15 : Only activity B is eligible. It requires 2programmers + 1 Machine. Load activity B into Schedule.**

**15 🡪20 : No activities are eligible to be scheduled.**

**20 🡪25 : No activities are eligible to be scheduled.**

**25 🡪30 : Only activity C is eligible. It requires 2programmers + 1 Machine. Load activity C into Schedule.**

**30 🡪35 : No activities are eligible to be scheduled.**

**35 🡪40 : No activities are eligible to be scheduled.**

**40🡪45 : No activities are eligible to be scheduled.**

**45🡪50 : No activities are eligible to be scheduled.**

**50 🡪55 : Only activity D is eligible. It requires 2programmers + 1 Machine. Load activity D into Schedule.**

**55🡪60 : No activities are eligible to be scheduled.**

**60🡪65 : No activities are eligible to be scheduled.**

**65🡪70 : No activities are eligible to be scheduled.**

**70🡪75 : No activities are eligible to be scheduled.**

**75🡪80 : Activity E, I, K are eligible to be scheduled . Activity E has the least slack, load activity E into Schedule.**

**Next load activity K (less duration than I), Activity I is next with slack of 5; however, activity I requires 2 programmers and only 1 is available**

**Delay activity I. Update: ES = 80, slack = 0.**

**80🡪85 : Activity I is eligible but exceeds limit of 5 programmers in pool.**

**Delay activity I. Update: ES = 85, slack = -5.**

**85🡪90 : Activity I, F, L is eligible to be scheduled. Activity I has the least slack (-5), load activity I into Schedule. Then load activity F .**

**Activity L is next with slack of 5; however, activity I requires 2 programmers and only 1 is available**

**Delay activity I. Update: ES = 90, slack = 0.**

**90🡪95 : Activity L is eligible but exceeds limit of 5 programmers in pool.**

**Delay activity L. Update: ES = 95, slack = -5.**

**95🡪100 : Activity L is eligible but exceeds limit of 5 programmers in pool.**

**Delay activity L. Update: ES = 100, slack = -10.**

**Activity J is eligible to be scheduled, but dependency ( I ) has not yet finished**

**Delay activity j. Update: ES = 100, slack = 0.**

**100🡪105 : Activities G, J, L are eligible.**

**Load activity L of slack(-10).**

**Delay activity G. Update: ES = 105, slack = -5.**

**Delay activity J. Update: ES = 105, slack = -5.**

**105🡪110 : Activities G, J,H are eligible.**

**Load activity G of slack(-5).**

**Delay activity J. Update: ES = 110, slack = -10.**

**Delay activity H. Update: ES = 110, slack = -5.**

**110🡪115 : Activities H, J are eligible.**

**Load activity J of slack(-10).**

**Load activity H of slack(-5).**

**115🡪120: No activities are eligible to be scheduled.**

**120🡪125: activity M is eligible to be scheduled ,However, dependency(L) is not completed.**

**Delay activity M. Update ES=125, slack=-5.**

**125🡪130 : activity M is eligible to be scheduled ,However, dependency(L) is not completed.**

**Delay activity M. Update ES=130, slack=-10.**

**130🡪135 : activity M is eligible to be scheduled ,load activity M.**

**.**

**.**

**.**

**So the project Network after resource allocation will be as follows ( critical paths illustrated by red arrows):**

|  |  |  |
| --- | --- | --- |
| 10 | B | 25 |
| 0 | Development specifications | |
| 10 | 15 | 25 |

|  |  |  |
| --- | --- | --- |
| 50 | D | 75 |
| 0 | **Database Design** | |
| 50 | 25 | 75 |

|  |  |  |
| --- | --- | --- |
| 75 | E | 85 |
| 0 | **Rack & server Setup** | |
| 75 | 10 | 85 |

|  |  |  |
| --- | --- | --- |
| 85 | F | 100 |
| 0 | **Datacenter Setup** | |
| 85 | 15 | 100 |

|  |  |  |
| --- | --- | --- |
| 105 | G | 110 |
| 0 | **Install router, switches & cables** | |
| 105 | 5 | 110 |

|  |  |  |
| --- | --- | --- |
| 110 | H | 125 |
| 0 | **Configure DNS & Gateway** | |
| 110 | 15 | 125 |

|  |  |  |
| --- | --- | --- |
| 85 | I | 105 |
| 0 | **Website Database And**  **authorization implementation** | |
| 85 | 20 | 105 |

|  |  |  |
| --- | --- | --- |
| 110 | J | 130 |
| 0 | **Website backend Testing &**  **Integrations** | |
| 110 | 20 | 130 |

|  |  |  |
| --- | --- | --- |
| 130 | M | 161 |
| 0 | **Integrate Frontend with Backend**  **and final testing** | |
| 130 | 31 | 161 |

|  |  |  |
| --- | --- | --- |
| 75 | K | 85 |
| 5 | **Prototype** | |
| 80 | 10 | 90 |

|  |  |  |
| --- | --- | --- |
| 100 | L | 130 |
| 0 | **UI/UX Design** | |
| 100 | 30 | 130 |

|  |  |  |
| --- | --- | --- |
| 25 | C | 50 |
| 0 | System Design | |
| 25 | 25 | 50 |

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | | A | 10 |
| 0 | **User specifications** | | |
| 0 | | 10 | 10 |