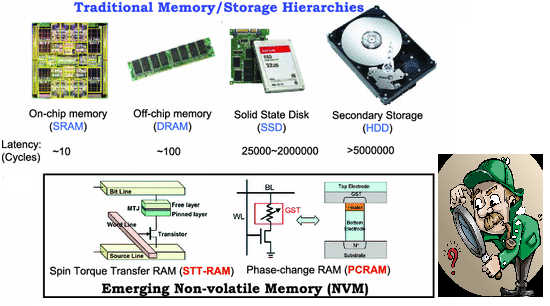
**Gen-X Memory Ramping Up: Mining and Forecast the case of Chip Masters**

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# The next-generation memory market is heating up as vendor’s ramp a number of new technologies, but there are some challenges in bringing these products into the mainstream. Thou, the conventional memories remain the mainstream products in systems, but the new memory types claiming they can outperform the traditional memories.  ReRAM and STT-MRAM are now leading candidates to replace conventional NAND or NOR flash memories and to pioneer the field of Storage Class Memories, while STT-MRAM is regarded as the only a non-volatile memory that can have the performance of DRAM due to its high-speed read/write and excellent cycling endurance. Adapting these trends, semi-conductor industry already started planning and implementing their production units to incorporate these revolutionary changes. One of such company is Chip Masters whose case is presented below for analyzing and prediction.

# Chip Masters has grown into one of the promising chipmakers in the world through continuous effort to secure a fundamental competitive edge in the fierce semiconductor industry since from their starting operation in 2016. With the emergence of new entrants and the consolidation of incumbent players, the competition and technological barriers are continuously heightening in the market. Chip Masters has five production facilities in Kolkata, Mumbai and Chennai, in India as well as domestic business sites in Dhaka and Kathmandu. As a global company, Chip Masters also operates sales subsidiaries in five countries including the U.K., Germany and China, also having some R&D corporate bodies across the world. Based on their senior management leadership in different arena of production and operation of semiconductor business, Chip Masters makes efforts to secure competitiveness in technology and costs and promising to lead the global semiconductor market by conducting continuous R&D activities and investment.

# Building on preceding effort, they are now accelerating the “Deep Change” of Chip Masters towards the title of “the best emerging semiconductor solution provider”. To keep pace with the rapidly-changing ICT industry and increasingly-complex needs of customers, Chip Masters will provide greater value to their customers with outstanding product performance. Chip Masters is particularly committed to acquiring competitiveness in memory chip technology, which is the core of the Fourth Industrial Revolution driven by technologies such as AI and autonomous vehicles. They are dedicating their effort to providing leading-edge solutions in this fast-paced market. Chip Masters is dedicated to continuous R&D and investment to achieve cost competitiveness and technological leadership in the global semiconductor market. In preparation of the future, Chip Masters is also focused on developing next-generation memory technologies such as PC RAM, STT-MRAM and ReRAM. Chip Masters will place its focus on expanding leading edge technologies and diversifying product portfolio to actively respond to the market demands. Therefore, it will consistently expand the portion of 1Xnm and hit its stride in the sales of 1Xnm server and graphics DRAM.

# In addition, the Company is to enter the enterprise SSD market with its PCIe products that have been recently validated by IDC clients. Furthermore, Chip Masters plans to stretch its cutting-edge 36-Layer 3D NAND to increase the sales of high density mobile applications and a variety of client SSD solutions.

**Challenges**

Keeping pace with the competitor's reduced distribution times was tough and customer service enhancement was not easy either in large dynamic market.

The key to success, however, depended in integrating disparate systems and achieving process efficiencies and accurate forecast of sales and distribution strategies. The challenges are:

* Attempt to visualize the Time series of the Chip Masters database (Given in Annex 1) and extract the trend, seasonality and errors.
* Legacy systems of the client hampered the synchronization of its operations with market fluctuations. Visualize such fluctuation using time series analysis.
* As the customer is in an extremely short life-cycle industry, the on-time delivery record had to be improved while keeping inventory levels and costs low. Discuss how associative rule mining will be helpful in this regard.
* Operating on disparate systems added to the complexity, as there were a large number of satellite systems running independent of the host. Can there will be any scope to de-centralize the promotional strategies based upon different location to boost up the sales using data mining techniques? If so then elaborate that.
* Guidelines of the technological platform suitable of Chip Masters to support R&D activities.
* Brief how firm wide Information system for Chip Masters will synchronize the various process operations in optimal way.
* Avenues to overcome the supply chain management related issues using Information Systems as centralized tool.
* Brief how business analysis will helpful to the, Chip Masters Company to accelerate their sales and market share in present competitive market space.
* Suggest some best possible Sales and Promotional strategies that the Company can consider based upon future market forecast using data mining tools and techniques.
* Analyzing the data warehouse of past sales dataset ( Given in Annex 1) show how Time Series Analysis can be helpful to graphically represent the next two years future trend of sales of ReRAM or PC RAM products.
* Perform cluster analysis to visualize the sales of products at different regions.

Suggest a brief overview to overcome the aforesaid challenges.

Annex1: Sample Sales Dataset of Chip Masters (Year 2017 to till date)

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| **10223** | **37** | **100** | **3965.66** | **2/20/2018 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_1678** | **Kathmandu** | **Medium** | | **10275** | **45** | **92.83** | **4177.35** | **7/23/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_1678** | **Kolkata** | **Medium** | | **10299** | **23** | **100** | **2597.39** | **9/30/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_1678** | **Dhaka** | **Small** | | **10309** | **41** | **100** | **4394.38** | **10/15/2018 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_1678** | **Mumbai** | **Medium** | | **10341** | **41** | **100** | **7737.93** | **11/24/2018 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_1678** | **Chennai** | **Large** | | **10361** | **20** | **72.55** | **1451** | **12/17/2018 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_1678** | **Kathmandu** | **Small** | | **10375** | **21** | **34.91** | **733.11** | **2/3/2019 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_1678** | **Kolkata** | **Small** | | **10403** | **24** | **100** | **2434.56** | **4/8/2019 0:00** | **Shipped** | **2** | **PC RAM** | **M10\_1678** | **UK** | **Small** | | **10103** | **26** | **100** | **5404.62** | **1/29/2017 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_1949** | **Mumbai** | **Medium** | | **10174** | **34** | **100** | **8014.82** | **11/6/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_1949** | **Kathmandu** | **Large** | | **10194** | **42** | **100** | **7290.36** | **11/25/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_1949** | **Kolkata** | **Large** | | **10270** | **21** | **100** | **4905.39** | **7/19/2018 0:00** | **Shipped** | **3** | **ReRAM** | **M10\_1949** | **Kathmandu** | **Medium** | | **10304** | **47** | **100** | **10172.7** | **10/11/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_1949** | **Kolkata** | **Large** | | **10347** | **30** | **100** | **3944.7** | **11/29/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_1949** | **Kathmandu** | **Medium** | | **10391** | **24** | **100** | **2416.56** | **3/9/2019 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_1949** | **Kathmandu** | **Small** | | **10120** | **29** | **96.34** | **2793.86** | **4/29/2017 0:00** | **Shipped** | **2** | **PC RAM** | **M10\_2016** | **Kathmandu** | **Small** | | **10134** | **27** | **100** | **3307.77** | **7/1/2017 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_2016** | **Kolkata** | **Medium** | | **10223** | **47** | **100** | **5422.39** | **2/20/2018 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_2016** | **Kathmandu** | **Medium** | | **10275** | **22** | **100** | **2904.44** | **7/23/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_2016** | **Kolkata** | **Small** | | **10298** | **39** | **96.34** | **3757.26** | **9/27/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_2016** | **Kolkata** | **Medium** | | **10361** | **26** | **51.15** | **1329.9** | **12/17/2018 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_2016** | **Kathmandu** | **Small** | | **10374** | **39** | **100** | **5288.01** | **2/2/2019 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_2016** | **Kathmandu** | **Medium** | | **10402** | **45** | **100** | **5833.8** | **4/7/2019 0:00** | **Shipped** | **2** | **PC RAM** | **M10\_2016** | **Kolkata** | **Medium** | | **10120** | **46** | **100** | **9264.86** | **4/29/2017 0:00** | **Shipped** | **2** | **PC RAM** | **M10\_4698** | **Kathmandu** | **Large** | | **10134** | **31** | **100** | **7023.98** | **7/1/2017 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_4698** | **Kolkata** | **Large** | | **10180** | **41** | **100** | **8892.9** | **11/11/2017 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_4698** | **Kolkata** | **Large** | | **10188** | **45** | **100** | **8714.7** | **11/18/2017 0:00** | **Shipped** | **4** | **PC RAM** | **M10\_4698** | **Mumbai** | **Large** | | **10223** | **49** | **100** | **9774.03** | **2/20/2018 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_4698** | **Kathmandu** | **Large** | | **10275** | **36** | **100** | **6901.92** | **7/23/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_4698** | **Kolkata** | **Medium** | | **10299** | **29** | **100** | **6683.34** | **9/30/2018 0:00** | **Shipped** | **3** | **PC RAM** | **M10\_4698** | **Dhaka** | **Medium** | | **10374** | **22** | **100** | **3834.38** | **2/2/2019 0:00** | **Shipped** | **1** | **PC RAM** | **M10\_4698** | **Kathmandu** | **Medium** | | **10403** | **66** | **100** | **11886.6** | **4/8/2019 0:00** | **Shipped** | **2** | **PC RAM** | **M10\_4698** | **UK** | **Large** | | **10119** | **46** | **100** | **5004.8** | **4/28/2017 0:00** | **Shipped** | **2** | **ReRAM** | **M10\_4757** | **Chennai** | **Medium** | | **10129** | **33** | **100** | **4398.24** | **6/12/2017 0:00** | **Shipped** | **2** | **ReRAM** | **M10\_4757** | **UK** | **Medium** | | **10155** | **32** | **100** | **4526.08** | **10/6/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **Dhaka** | **Medium** | | **10178** | **24** | **100** | **3492.48** | **11/8/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **Kolkata** | **Medium** | | **10186** | **26** | **100** | **3854.24** | **11/14/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **UK** | **Medium** | | **10316** | **33** | **100** | **4128.96** | **11/1/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **UK** | **Medium** | | **10325** | **47** | **64.93** | **3051.71** | **11/5/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **Mumbai** | **Medium** | | **10359** | **48** | **54.68** | **2624.64** | **12/15/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4757** | **Kolkata** | **Small** | | **10373** | **39** | **100** | **4046.25** | **1/31/2019 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_4757** | **Dhaka** | **Medium** | | **10395** | **32** | **100** | **3370.56** | **3/17/2019 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_4757** | **Kolkata** | **Medium** | | **10103** | **42** | **100** | **5398.26** | **1/29/2017 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_4962** | **Mumbai** | **Medium** | | **10114** | **31** | **100** | **4305.28** | **4/1/2017 0:00** | **Shipped** | **2** | **ReRAM** | **M10\_4962** | **Kolkata** | **Medium** | | **10164** | **21** | **100** | **3536.82** | **10/21/2017 0:00** | **Resolved** | **4** | **ReRAM** | **M10\_4962** | **Chennai** | **Medium** | | **10175** | **33** | **100** | **5362.83** | **11/6/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4962** | **UK** | **Medium** | | **10194** | **26** | **100** | **4263.74** | **11/25/2017 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4962** | **Kolkata** | **Medium** | | **10270** | **32** | **100** | **4302.08** | **7/19/2018 0:00** | **Shipped** | **3** | **ReRAM** | **M10\_4962** | **Kathmandu** | **Medium** | | **10347** | **27** | **100** | **4428** | **11/29/2018 0:00** | **Shipped** | **4** | **ReRAM** | **M10\_4962** | **Kathmandu** | **Medium** | | **10370** | **35** | **65.63** | **2297.05** | **1/20/2019 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_4962** | **Kathmandu** | **Small** | | **10391** | **37** | **46.9** | **1735.3** | **3/9/2019 0:00** | **Shipped** | **1** | **ReRAM** | **M10\_4962** | **Kathmandu** | **Small** | | **10425** | **38** | **100** | **5894.94** | **5/31/2019 0:00** | **In Process** | **2** | **ReRAM** | **M10\_4962** | **Kolkata** | **Medium** | | **10122** | **42** | **100** | **7599.9** | **5/8/2017 0:00** | **Shipped** | **2** | **ReRAM** | **S12\_1099** | **Kolkata** | **Large** | | **10169** | **30** | **100** | **5019.9** | **11/4/2017 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1099** | **Kathmandu** | **Medium** | | **10181** | **27** | **100** | **5411.07** | **11/12/2017 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1099** | **Mumbai** | **Medium** | | **10211** | **41** | **100** | **7498.9** | **1/15/2018 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_1099** | **Kolkata** | **Large** | | **10253** | **24** | **100** | **3922.56** | **6/1/2018 0:00** | **Cancelled** | **2** | **ReRAM** | **S12\_1099** | **UK** | **Medium** | | **10341** | **45** | **79.65** | **3584.25** | **11/24/2018 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1099** | **Chennai** | **Medium** | | **10363** | **33** | **85.39** | **2817.87** | **1/6/2019 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_1099** | **Dhaka** | **Small** | | **10375** | **45** | **76** | **3420** | **2/3/2019 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_1099** | **Kolkata** | **Medium** | | **10419** | **12** | **100** | **1961.28** | **5/17/2019 0:00** | **Shipped** | **2** | **ReRAM** | **S12\_1099** | **Chennai** | **Small** | | **10208** | **46** | **100** | **8602.92** | **1/2/2018 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_1108** | **Kolkata** | **Large** | | **10247** | **44** | **100** | **10606.2** | **5/5/2018 0:00** | **Shipped** | **2** | **ReRAM** | **S12\_1108** | **Dhaka** | **Large** | | **10306** | **31** | **100** | **6570.76** | **10/14/2018 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1108** | **UK** | **Medium** | | **10325** | **42** | **64** | **2688** | **11/5/2018 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1108** | **Mumbai** | **Small** | | **10336** | **33** | **57.22** | **1888.26** | **11/20/2018 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1108** | **Kolkata** | **Small** | | **10359** | **42** | **100** | **4764.48** | **12/15/2018 0:00** | **Shipped** | **4** | **ReRAM** | **S12\_1108** | **Kolkata** | **Medium** | | **10395** | **33** | **69.12** | **2280.96** | **3/17/2019 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_1108** | **Kolkata** | **Small** | | **10103** | **27** | **100** | **3394.98** | **1/29/2017 0:00** | **Shipped** | **1** | **STT-MRAM** | **S12\_1666** | **Mumbai** | **Medium** | | **10164** | **49** | **100** | **6563.06** | **10/21/2017 0:00** | **Resolved** | **4** | **STT-MRAM** | **S12\_1666** | **Chennai** | **Medium** | | **10174** | **43** | **100** | **6817.22** | **11/6/2017 0:00** | **Shipped** | **4** | **STT-MRAM** | **S12\_1666** | **Kathmandu** | **Medium** | | **10194** | **38** | **100** | **4933.92** | **11/25/2017 0:00** | **Shipped** | **4** | **STT-MRAM** | **S12\_1666** | **Kolkata** | **Medium** | | **10216** | **43** | **100** | **5759.42** | **2/2/2018 0:00** | **Shipped** | **1** | **STT-MRAM** | **S12\_1666** | **Kolkata** | **Medium** | | **10270** | **28** | **100** | **4094.72** | **7/19/2018 0:00** | **Shipped** | **3** | **STT-MRAM** | **S12\_1666** | **Kathmandu** | **Medium** | | **10304** | **39** | **100** | **6396** | **10/11/2018 0:00** | **Shipped** | **4** | **STT-MRAM** | **S12\_1666** | **Kolkata** | **Medium** | | **10391** | **39** | **63.2** | **2464.8** | **3/9/2019 0:00** | **Shipped** | **1** | **STT-MRAM** | **S12\_1666** | **Kathmandu** | **Small** | | **10121** | **50** | **100** | **8284** | **5/7/2017 0:00** | **Shipped** | **2** | **PC RAM** | **S12\_2823** | **Kolkata** | **Large** | | **10134** | **20** | **100** | **2711.2** | **7/1/2017 0:00** | **Shipped** | **3** | **PC RAM** | **S12\_2823** | **Kolkata** | **Small** | | **10169** | **35** | **100** | **4639.25** | **11/4/2017 0:00** | **Shipped** | **4** | **PC RAM** | **S12\_2823** | **Kathmandu** | **Medium** | | **10180** | **40** | **100** | **6747.6** | **11/11/2017 0:00** | **Shipped** | **4** | **PC RAM** | **S12\_2823** | **Kolkata** | **Medium** | | **10211** | **36** | **100** | **4771.8** | **1/15/2018 0:00** | **Shipped** | **1** | **PC RAM** | **S12\_2823** | **Kolkata** | **Medium** | | **10224** | **43** | **100** | **6087.94** | **2/21/2018 0:00** | **Shipped** | **1** | **PC RAM** | **S12\_2823** | **Kolkata** | **Medium** | | **10299** | **24** | **100** | **4157.04** | **9/30/2018 0:00** | **Shipped** | **3** | **PC RAM** | **S12\_2823** | **Dhaka** | **Medium** | | **10309** | **26** | **100** | **4660.24** | **10/15/2018 0:00** | **Shipped** | **4** | **PC RAM** | **S12\_2823** | **Mumbai** | **Medium** | | **10403** | **66** | **100** | **8648.64** | **4/8/2019 0:00** | **Shipped** | **2** | **PC RAM** | **S12\_2823** | **UK** | **Large** | | **10208** | **26** | **100** | **3142.36** | **1/2/2018 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_3148** | **Kolkata** | **Medium** | | **10247** | **25** | **100** | **4381.25** | **5/5/2018 0:00** | **Shipped** | **2** | **ReRAM** | **S12\_3148** | **Dhaka** | **Medium** | | **10363** | **34** | **96.73** | **3288.82** | **1/6/2019 0:00** | **Shipped** | **1** | **ReRAM** | **S12\_3380** | **Dhaka** | **Medium** | | **10419** | **34** | **90.17** | **3065.78** | **5/17/2019 0:00** | **Shipped** | **2** | **ReRAM** | **S12\_3990** | **Chennai** | **Medium** | | **10141** | **21** | **100** | **2140.11** | **8/1/2017 0:00** | **Shipped** | **3** | **STT-MRAM** | **S12\_4473** | **Dhaka** | **Small** | | **10103** | **35** | **100** | **3920** | **1/29/2017 0:00** | **Shipped** | **1** | **STT-MRAM** | **S18\_1097** | **Mumbai** | **Medium** | | **10155** | **38** | **100** | **6531.44** | **10/6/2017 0:00** | **Shipped** | **4** | **LED ICs** | **S18\_1662** | **Dhaka** | **Medium** | | **10178** | **42** | **100** | **6490.68** | **11/8/2017 0:00** | **Shipped** | **4** | **LED ICs** | **S18\_1662** | **Kolkata** | **Medium** | | **10186** | **32** | **100** | **6004.8** | **11/14/2017 0:00** | **Shipped** | **4** | **LED ICs** | **S18\_1662** | **UK** | **Medium** | | **10284** | **45** | **100** | **5747.85** | **8/21/2018 0:00** | **Shipped** | **3** | **LED ICs** | **S18\_1662** | **Mumbai** | **Medium** | | **10316** | **27** | **100** | **3704.13** | **11/1/2018 0:00** | **Shipped** | **4** | **LED ICs** | **S18\_1662** | **UK** | **Medium** | | **10351** | **39** | **99.52** | **3881.28** | **12/3/2018 0:00** | **Shipped** | **4** | **LED ICs** | **S18\_1662** | **UK** | **Medium** | | **10373** | **28** | **57.55** | **1611.4** | **1/31/2019 0:00** | **Shipped** | **1** | **LED ICs** | **S18\_1662** | **Dhaka** | **Small** | | **10398** | **33** | **100** | **4215.09** | **3/30/2019 0:00** | **Shipped** | **1** | **LED ICs** | **S18\_1662** | **Kolkata** | **Medium** | | **10110** | **42** | **100** | **6069** | **3/18/2017 0:00** | **Shipped** | **1** | **Nano Memory Chip** | **S18\_1749** | **UK** | **Medium** | | **10193** | **21** | **100** | **3141.6** | **11/21/2017 0:00** | **Shipped** | **4** | **Nano Memory Chip** | **S18\_1749** | **Kathmandu** | **Medium** | | **10180** | **25** | **64.2** | **1605** | **11/11/2017 0:00** | **Shipped** | **4** | **PC RAM** | **S18\_2625** | **Kolkata** | **Small** | | **10188** | **32** | **65.42** | **2093.44** | **11/18/2017 0:00** | **Shipped** | **4** | **PC RAM** | **S18\_2625** | **Mumbai** | **Small** | |