

Seatek Systems Pte Ltd

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SEATEK SYSTEMS PTE LTD

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When the phone rang, Mr. Y.K. Lang, general manager of Seatek Systems in Singapore, was considering his alternatives after a sobering meeting with the two PERT Associates consultants, who demonstrated why the M2K data logger would fail in the field. "Mr. Lang," said the contract manager of InduCorp icily, "if you can't offer a satisfactory solution to the field problems by September 1, 2001, consider the contract for the supply and installation of 500 M2K terminated... Oh, we also reserve the right to pursue compensation." Mr. Lang looked at the calendar and murmured to himself, "six weeks left!"

Associate Professor Tang Hung Kei prepared this case. As the case is not intended to illustrate either effective or ineffective practices or policies, the information presented reflects the author's interpretation of events and serves merely to provide opportunities for class discussion. The author has disguised names and other identifying information to protect confidentiality.

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SEATEK SYSTEMS AND SEATEK HOLDING

Seatek Systems Pte Ltd (SS) specialised in providing process control and automation systems to industrial companies in Singapore and neighbouring countries. The company typically purchased standard hardware, developed its own software, and integrated the two for customers on a project-to-project basis. In situations where special hardware were required, SS would turn to a sister company to have them designed and manufactured. SS was one of the many subsidiaries owned by the giant conglomerate Seatek Holding (SH), which prided itself as a premier multi-technology company in Singapore and South East Asia. In 2000, SH's turnover was close to half a billion dollars. With its breadth of engineering capability and financial resources, SH was able to undertake large engineering projects from the Singapore government and major corporations. Established in the 1960s, it had grown steadily and in the 1990s, began to diversify into infrastructure development projects both in and out of Singapore. As it diversified, new subsidiaries would be spun off from the larger established ones. Each subsidiary was run with a great degree of autonomy and was responsible for its own profit and loss. Each subsidiary also developed its own products and technologies. There was no centralised R&D.

In line with the Singapore government's frequent call and support for entrepreneurship¹, top management in SH encouraged senior managers to seize opportunities for growth through expanding and deepening the technology base of the companies under their charge. The manager of a subsidiary could approach top management directly for the financing of new business development. The approval process was usually swift and the evaluating criterion straightforward. It only required the proposed new business to be providing "quality technology-based products and services" and the only targets set were return on investment (ROI) and value-add (VA) per employee. The top management's attitude was perceived by many in the companies as paternalistic and loyalty to the company's management was a treasured trait. It was a commonly held belief that doers in the companies would survive mistakes as long as they put in good efforts.

In 1996, SS was newly spun off from a sister company due to the former's rapid increase in sales.

SS had 40 employees, 30 of whom were engineers. The company was organised into four specialisation groups, Software, Process Control, Automation, and Communication Network. (See **Exhibit 1** for the organisation chart.) SS had been growing very fast, and the size of its workforce tripled in 1996. K.L. Chay, a rising "star" perceived by many as a "blue-eyed boy" of top management, was made the general manager. K.L. Chay had joined the sister company as an engineer but quickly rose up the rank into the senior managerial level because of his flair for business. As a matter of fact, K. L. Chay was credited with winning many business contracts for SS's sister company in his previous position there.

THE DATA LOGGER PROJECT

One day in September 1997, K.L. Chay learnt that InduCorp, a company that supplied industrial consumables, was planning to finally replace its many antiquated chart recorders (which recorded the amount and rates of various consumables used) located throughout Singapore at the sites of its large industrial and commercial consumers, in the next few years. Sensing an opportunity to expand SS's business portfolio, K.L. Chay brought two engineers and a marketing executive along and met the person in InduCorp in charge of the project. They quickly learnt that InduCorp was sourcing for data loggers to replace the recorders as the means of recording the quantity and the rate of which the InduCorp consumables were used up. When "interrogated" by a central computer at InduCorp via the public telephone network, the data loggers would transmit the stored data to the central computer. The data loggers needed to be ruggedized because the ambient condition of remote sites was usually harsh. A few thousand data loggers would be required to replace all the existing chart recorders. The host told the visitors that InduCorp would certainly like to try out any solution that SS might come out with.

The next day, K. L. Chay disclosed to a selected group in SS that he intended to take on the challenge of producing the data loggers for InduCorp. He believed that such an endeavour would expand the technological capability of the company and bring it to greater heights. This new challenge was greeted enthusiastically by the group. But after the initial elation had subsided, someone raised the point that this would mean a regular departure from the

¹ In the 1990s, the Singapore government began to actively promote innovation and technological entrepreneurship, through various schemes administered by the then National Science and Technology Board, and the Economic Development Board.

company's *modus operandi* of buying hardware and developing only software. Another echoed that SS had neither the hardware engineers nor equipment for hardware development. Yet another suggested that SS could outsource the hardware development to the sister company which had been serving SS quite satisfactorily. At this point, K. L. Chay immediately put on a solemn countenance and said emphatically, while waving his finger in the air, "Not a word to our sister company until the deal is done." At the end of the meeting, K. L. Chay reminded those present of the nation's quest towards entrepreneurship and that, entrepreneurs could not be pessimists. The engineer, Adrian Kung, who until then, had been working most closely on hardware development with the sister company was appointed to head the preparation for the proposal. In November 1997, with the project proposal complete with costing and sales forecast in hand, K. L. Chay approached SH and succeeded in obtaining project funding. The deal was closed and the hard work began.

K. L. Chay formed the Hardware Group, the fifth specialisation group in SS for the data logger project. He assigned four engineers from the other four groups to the Hardware Group, including Adrian who was made group leader. However, all four engineers worked on the project only on a part-time basis and still reported to their respective group leaders. (See **Exhibit 1.**) Hardware development equipment dedicated to the project were purchased. In June 1998, a new technician dedicated to the project was hired to help the engineers.

Technical and organisational difficulties beset the project almost from the start. Adrian, being a lightweight team leader, had problems getting the other three engineers to dedicate sufficient time to the project. The original project schedule was found to be too optimistic in view of the technical difficulties encountered and the troubleshooting required. 1998 was also a bad year for SS; sales were sluggish due to the aftermath of the 1997 Asian financial crisis. Moreover, the rapid expansion of the previous year had dramatically increased SS's overhead and capital expenditures. K. L. Chay's attention to the newly formed hardware group and the data logger soon diminished. He was under pressure to show better results and that could only come from the other groups. Nevertheless, the Hardware Group slogged on. By August 1998, one of the four engineers resigned and was not replaced. Finally in November 1998, six months later than the original target date, InduCorp was invited to view the prototype. The response was encouraging but InduCorp wanted many more features to be

implemented. One month later, Adrian who felt burn-out, asked for and was transferred to a marketing position in a sister company. Adrian's role in the Hardware Group was taken over by T. S. Moon, a relatively newcomer from the Automation Group. From then on, the Hardware Group worked full-time on the data logger project. K. L. Chay even added a software specialist to the group. In the run-up to the final version of the data logger, T.S. Moon decided to make some changes to the unit's design to make it less costly to build. One of the changes was the replacement of the original power supply module specified by Adrian with one that was less expensive and appeared to work equally well. One year later, the final version of the data logger, which had since been given the model name M2K, was ready and a unit was installed at a site provided by InduCorp for field testing. It performed satisfactorily.

In December 1999, InduCorp called for an open tender for the supply and installation of 500 units of the data logger that must meet its specification. The successful bidder would install the units in batches at the sites over a two-year period. In January 2000, SS and other companies submitted their bids. A month later, InduCorp awarded the contract to SS. Incidentally in the same month, K. L. Chay was promoted and transferred to a much bigger sister company. He was replaced by Mr. Y. K. Lang who had been a leader of the Automation Group in SS.

THE 80/20 PROBLEM

Following the installation of the initial batch of 50 units of the M2K data logger at the sites, InduCorp detected problems at 17 sites. 80 percent of these problems fell in the category of missing counts resulting in significant data inaccuracy. The remaining 20 percent were an assortment of other problems, the most serious one being "system hang". The M2K in this mode would "freeze up" and not function again until it had been manually reset. Some of the problems were easily diagnosed and rectified. A few of the remaining problems, including the more widespread problem of missing counts, occurred intermittently and randomly. After a time lapse, the problems disappeared all together, only to recur at a later period. The SS engineers, like the proverbial cat, were frustrated by the elusive mouse. T. S. Moon replaced the power supply module in a M2K unit with the module specified earlier by Adrian in the old design. He returned the next day to check on the unit. To his "relief" - it also failed by missing counts. Although Y. K. Lang did not know all the details, he sensed that something was seriously wrong. So he decided a consultant

was needed to end the impasse. Upon the suggestion of two of the Hardware Group's engineers, the electromagnetic interference² (EMI) specialist from a sister company was brought in as the consultant. Testing the M2K using standard procedures and special equipment, he observed two failure modes. The first which was caused by conducted EMI, did not resemble the failure modes reported in the field, whereas the second caused by radiated EMI did bear some resemblance to the missing counts failure. Therefore, he concluded that the M2K was susceptible to EMI radiated by heavy-duty electric equipment nearby. His recommended solution was a properly shielded housing for the M2K. So the housing of one M2K at a known bad site was reinforced with additional shielding materials. (See **Exhibit 5**.) However, the same old problem of missing counts persisted.

In March 2001, Y. K. Lang approached the technical consultant firm PERT Associates who assigned Ken Oh to the project. At their first meeting, T. S. Moon described the M2K problems and attempts to solve them. Then Y. K. Lang laid out the guidelines. Ken Oh must solve the problems within two months and recommend the least costly solution because the M2K project's projected profits were at danger of turning into losses. To avoid delays, Ken Oh and the consultants would liaise directly with T. S. Moon.

In May 2001, after studying the design and making measurements in the field, Ken Oh submitted his report to T. S. Moon. The first recommendation was the simplest; SS would change one line of software instructions stored in the firmware of the M2K chip. This would prevent missing counts even with EMI. The recommendation was quickly implemented and the problem with the missing counts indeed vanished. The remaining six recommendations were aimed at the rest of the problems. However, Ken

Oh cautioned that these were low-cost, expedient solutions. They did not address the root cause of the problems that Ken Oh suspected was due to the EMI being conducted into the M2K unit via the power cable and the power supply module. This cautionary advice was ignored by T.S. Moon. Instead he chose to try out the remaining six recommendations one by one. He rationalised that since 80 percent of the problems were solved with just one solution there was hope that the remaining 20 percent would be solved with six solutions. However, that proved to be wishful thinking on his part. While there were improvements, none of them was as major and conclusive like the first solution. As time went by, Y. K. Lang who relied only on T. S. Moon to update him on the situation, became anxious. He had been told that the consultants' solutions only worked partially but was not told of the cautionary advice. Finally in mid-July 2001, he asked T. S. Moon to arrange a meeting with Ken Oh. During the meeting, Ken Oh made a very simple demonstration. He plugged an electric kettle into the power socket next to the M2K's. When the kettle was either switched on or off, a large disturbance on the M2K internal signal paths could be observed with an instrument. Although the M2K did not fail to function in the demonstration, the disturbance clearly violated the operation conditions specified for the M2K's IC chips. With such disturbance, which was known to occur frequently and randomly in the field, the M2K would fail sooner or later under the "right" set of conditions. Y. K. Lang had heard and seen enough. With a somber face, he bid the consultants goodbye and returned to his office.

Soon after the consultants left, Y. K. Lang received the phone call from the contract manager of InduCorp who issued the September 1 deadline for solving the field problems experienced by the M2K data logger.

2 EMI refers to electromagnetic noise or disturbance that interferes with the normal operation of electronics and electrical equipment.

EXHIBIT 1
ORGANIZATION CHART
1996

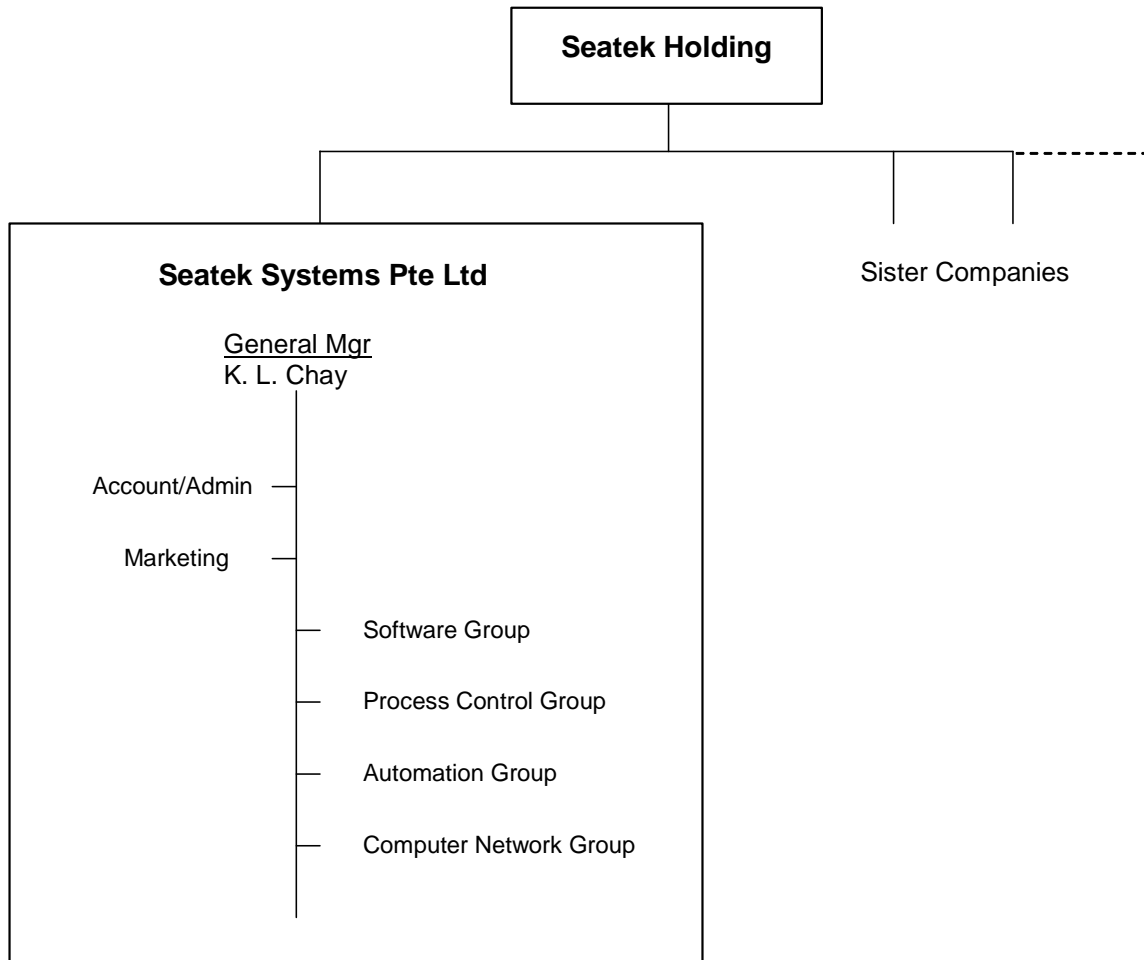


EXHIBIT 2

A CHRONOLOGY OF SS'S HARDWARE GROUP

Date	Hardware Group Members	Remarks
Nov 1997	Formation of the Hardware Group comprising Adrian Kung, the nominal leader and three other engineers.	All four engineers continued to report to their respective group leaders. Adrian also reported to SS General Manager K. L. Chay on matters related to the data logger project. Adrian did not have the authority over the other three members. All four still worked on other projects assigned by their respective group leaders.
Jun 1998	A new technician was hired to help Adrian and work exclusively on the data logger project.	
Aug 1998	An engineer from the Hardware Group resigned from the company and was not replaced.	
Nov 1998	Adrian asked for and was granted a transfer to a sister company in the SH group. T. S. Moon took over his job. A new software specialist was hired to join the hardware group which constituted four engineers (including the software specialist and Moon) and one technician.	T. S. Moon joined SS in 1996 but had not worked previously on the data logger project. All members of Hardware Group began to work full time on the data logger project. T. S. Moon from the Automation Group was promoted to group leader of Hardware Group with authority over members of the group. He reported to K. L. Chay.
Feb 2000		K. L. Chay was promoted and transferred to a sister company. Y. K. Lang the leader of the Automation Group was promoted to be the new General Manager.

EXHIBIT 3

SH'S VISION AND MISSION

Vision: To be recognized as the premier company at home and abroad, in the 21st century and beyond.

Mission: To create value for our customers through quality products and outstanding services at competitive prices and superior returns.

EXHIBIT 4

**THE PROJECTED ACCUMULATED PROFITS
OF THE M2K PROJECT BASED ON 1000 UNITS SOLD TO INDUCORP,
PREPARED IN DECEMBER 1998.**

End of	Accumulated Profits Projected in 1998	Actual Accumulated Profits
1998	(500k)	(500k)
1999	(1500k)	(1800k)
2000	(750k)	(1000k)
2001	0	n.a.
2002	800k	n.a.

EXHIBIT 5

BLOCK DIAGRAM OF THE M2K AND POSSIBLE EMI PATHS

