From Klondike (Yukon) to Kampar (Malaya): The transfer of dredging technology by Yukon Gold Company

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Abstract: *This paper seeks to study when and why dredging technology was introduced and in what way was it able to transform the Malayan tin mining industry. What were the advantages and limitations of dredging technology as compared to other mining methods? Emphasis would be placed upon the role played by Yukon Gold Company (henceforth YGC), the sole American entrant in Malayan tin mining industry towards the transfer of dredging technology with a focus on how local conditions affected technological development.*

Dredging technology developed in New Zealand in the 1880's. This technology steadily spreads to the gold and tin mines of Australia, undergoing significant transformation at the gold fields of Alaska and California. The YGC was organized in 1906 by the Guggenheim Brothers to operate gold mines at Klondike and California. In an effort to diversity as a result of losses incurred at their Yukon mines in 1917 and 1918, action was taken to send a prospecting party to Malaya. YGC was prompted to diversity into tin mining due to the similarities of gold and tin dredging, the availability of mining technology and technical expertise.

With the successful introduction of dredges, mining technology graduated from labour intensive techniques to capital intensive techniques giving western enterprises an added advantage over local enterprise, mainly represented by small scale Chinese miners using gravel pumping, open cast mining and dulang washing. Dredging technology established the western dominance in the industry. YGC was among the early western entrants who had the technological advantage and the financial resources for a large scale dredging technology. These innovative

technological developments were also adopted by other mining firms, in the process maximised the Malayan tin ore potentials producing greater capacity, flexibility and better saving of tin. Dredging output increased from 30 per cent of the Malayan tin output in the 1920's to 50 per cent by 1938. Tin revenue too, increased between 10 to 24 per cent of the total revenue from 1920 to 1938 an Malaysian tin production maintained a one-third shared of the total world production.

YGC became amongst the cheapest of the procedures in Malaysia and the mining venture in Malaysia proved to be profitable to YGC. By 1933 YGC became the sole venture that prompted a name change in 1938 to Yukon-Pacific Mining Corporation, and in 1939, to Pacific Tin Consolidated Corporation when it was listed on the New York Stock Exchange.

Keywords: *tin mining, dredging technology, international business, Yukon Gold Company, Pacific Tin Consolidated Corporation, Malaysia.*

Introduction

This paper seeks to study the role played by Yukon Gold Company (henceforth YGC), the sole American entrant in the Malayan tin mining industry during the interwar years towards the transfer of dredging technology. It focuses on how local conditions affected technological development. Two main factors prompted YGC to diversify into tin mining in Malaya post World War One. Firstly, losses incurred at their Yukon mines in Canada; secondly its ownership advantages of tangible and intangible resources essentially technological advantages, financial resources, managerial expertise from its worldwide dredging operations. Most importantly, YGC was able to use these advantages to successfully localize the dredging technology. These innovative technological developments were also adopted by other mining firms; in the process they maximized the Malayan tin ore potentials producing greater capacity, flexibility and better saving of tin. YGC too, became among the cheapest of producers in Malaya. By 1933, tin mining in Malaya became its sole venture, prompting a name change in 1938 to Yukon-Pacific Mining Corporation; and in 1939, to Pacific Tin Consolidated Corporation when it was listed on the New York Stock Exchange.

I shall begin by looking at the introduction of dredging technology and the impact upon the progress of the Malayan tin mining industry. I will then

briefly discuss the formation of the American multinational and concentrate on how, when and why they diversified into tin mining in Malaya. Thirdly, I will discuss the problem encountered and the solution adopted in this capital-intensive dredging venture. Finally, I shall conclude by a brief outline of the firm's performance.

The Beginnings of Dredging Technology - Impact on the Malayan Tin Mining Industry

Since 1883, Malaya was producing about one-third of the world's tin output.[1] Between the years 1874-1896, Chinese miners were the main producers of tin in Malaya. Operating through the open-cast mining system they used a large labour force based on a "tribute" or profit-sharing system. On the other hand, in order to induce Western enterprises to participate in the tin mining industry, British administrators offered special concessions provided that there was employment of Western financial and technical management. However, many mining entities failed in their extraction ventures for the following reasons: overly-ambitious schemes, the high costs of employing European staff, difficulty in employing Chinese labours,[2] the use of expensive European machinery and most importantly, the failure to adapt to the local mining conditions.[3] Although 35 companies were registered in the UK to mine tin in Malaya between 1882-1897, only three foreign companies remained active in Perak and Selangor.[4]

In 1892, the British established the Gopeng Tin Mining Company. Here new techniques used in Californian gold mines - hydraulic mining - were introduced by Douglas Osborne and G. Pike using American equipment or machinery.[5] This technique was then perfected, providing the springboard for Western penetration vis-à-vis pre-existing Chinese domination in the Malayan tin mining industry. By 1905, there were nine hydraulic mines - Chinese-owned ones - in the Federated Malay States (henceforth FMS).[6]

In the late nineteenth century due to reserve exhaustion, falling prices and increased world production, the early dredging companies came from Australia and Cornwall (UK). Malaya was the obvious choice due to its natural resource endowments. However, tin deposits in Malaya were mainly of alluvial deposits and not lode deposits as those found in the Cornish

mines. As such, Cornish technologies, through developed earlier, were not compatible with the Malayan conditions. Only in Pahang were lode deposits found; and consequently in 1897, the Pahang Corporation Limited was able to successfully mine Malaysia's largest tin lode area using Cornish technology.[7] However they failed to succeed in areas with alluvial deposits. As such, the Australians and the Americans had an upper hand in adapting this technology to the Malayan conditions, as they were familiar with gold mining. They were able to successfully transfer the technologies of gold mining to tin mining due to similar properties and occurrence in alluvial deposits.

Dredging technology developed in New Zealand in the 1880s to recover gold was known as the bucket elevator.[8] This technology was then used in the gold and tin mines of Australia and finally underwent significant transformation at the gold fields of Yukon and California. Here the Americans perfected the techniques and despite not being the pioneers, were able to play an important role in upgrading the efficiency of the gold dredging. It was the same persistence that could be seen in the Malayan venture by the Americans as portrayed by YGC.

In 1912, the bucket dredge was launched in Perak by the Americans - contributing to the mining technology when they introduced the gold dredge which became one of the principal mining methods.[9] Bucket dredge allowed the recovery of tin at a lower cost and a dredge with 12 foot buckets was equivalent to 2,000 Chinese coolies.[10] This not only overcame labour problems but in the process led to the reduction of production costs. The onset of the First World War led to shipping difficulties thus delaying the exploitation of dredging technology. Only in the 1920s was Malaya's full mining potential was realised. Mining technology graduated from labour intensive techniques to capital-intensive techniques giving western enterprises an added advantage over local enterprises mainly represented by small-scale Chinese miners. The factor for these advancements in Malaya was the use of dredges which due to its high costs created barriers for entry, radically shifting the balance between Chinese and western enterprise. In 1920, there were 20 dredges and by 1928, dredging contributed 30 per cent

of the tin mining methods in Malaya as compared to 45 percent for grave pumping; 6 percent open cast; 6 per cent underground; and 2 per cent dulang.[11] By the Second World War, dredging produced 50 per cent of the total tin output.[12] By 1930, European production accounted for 63 per cent of Malayan total output as compared to 28 per cent in 1915 whilst Chinese production dropped to 37 per cent from 72 percent in 1915.[13]

Foreign investments in the Malayan tin mining in 9120 totalled S$19,588,320 (£5,352,000) rising to S$58,888,620 (£12.117,000) in 1927. The foreign registered portion (Australian, British, French and American) increased to 82 per cent whilst the remaining percentage was locally registered. Of the increase, 85 per cent was British in origin. In 1923, the U.S. Department of Commerce audited that the US$5 million in tin investments (equivalent to £1 million) came from YGC.[14]

The Origin of YGC

YGC was formed in 1906 by Guggenheim Brothers[15] and was registered under the laws of the State of Maine in 1907. YGC was then operating gold mines in Klondike, Yukon Territory, and California. However, due to losses incurred at their Yukon mines in the years 1917 and 1918, YGC began to explore the possibilities of tin mining in Malaya. As such, a mission was sent to the FMS to explore the viability of producing tin in Malaya. One important factor that prompted YGC to diversity into tin mining was the set of experienced staff with prior experience on the Klondike and Californian fields. Furthermore, physical asset specificity - expensive equipment - could be released from expired gold operations. The management of Guggenheim Brothers placed emphasis on the need to seek and acquire new properties to replace exhausted properties by means of current earning to defray the cost. This was achieved through YGC's policy where competent engineers were recruited to seek potential properties throughout the world.

Hence, in January 1919, the year Malayan tin potentials were brought to their attention, a prospecting party headed by engineers Charles H. Munro and Professor John Flesher Newsom was sent there followed by Colonel O. B. Perry, Consulting Engineer and General Manager of YGC. Colonel Perry was impressed with the promising outlook offered by Malaya's tin mining

industry. Newsom and Munro in the meantime were seeking out prospecting licences and mining leases for YGC. Their activities were concentrated in the main tin producing states of Perak and Selangor filing several applications for prospecting licences at the Kinta Land Office, Perak, and at the Land Office in Kuala Lumpur, Selangor in the years 1919-1921.[16] If deemed suitable, they would then file applications for mining leases. YGC, however, carried out extensive research to ensure the viability of their investment. Two special reports were prepared by Perry and Munro, the former dealing with all properties; and the latter pertaining to the newly-acquired alluvial tin properties in the Malay States. The latter also wrote a comprehensive review of the mining situation in Malaya.[17]

During this period, the British government controlled all mining lands in the FMS; and in the twenties, mining lease was generally granted for 21 years. Prospecting licence was issued for six months at a fee of S$25 and with the right to choose the whole acres at a premium of S$10 per acre. If requirements were met, the lease may be renewed when it expired. The British government encouraged large mining operations provided the latter did not interfere with the government policy. However, there were inconsistencies in approving mining leases that sometimes took a long time to be processed and approved.[18] It should be noted that decisions were made by local authorities and depended very much on the discretion of the official at hand. Although, applications for British concessions were often dealt with promptly, there were instances when their application too were at times refused. Unlike the British applications, most foreign application took several months to process which in the end, were sometimes refused.[19] In the early 20s YGC experienced similar delays in their applications. Wilkin (1984) wrote:

"When asked if it was difficult for an American company to invest in Malaya, Charles Earl, a director of Yukon Gold, replied that it took two to three years for the company to get establish. The company sent out "several engineers, and, with the assistance of native engineers, they finally gathered up this territory, the tin bearing areas, and then they went through a long siege with the government officials to get the necessary licenses and permits

and concessions in exchange for agreement on their part concerning supervision, limitation of production when required, rate of development, the disposal of the product to local smelters and various other things. They had made these agreements in order to get permission to mine the ground."[20]

These delays however, did not deter the entrepreneurial efforts of YGC engineers who persisted with their applications to invest in Malayan tin mines. In the process, they had to deal with several problems before being able to make the Malayan tin mining endeavour a profitable venture.

YGC's Management: Difficulties Encountered and Surmounted

The initial difficulties encountered by the company were securing options significant enough to justify the use of large scale dredging operations. As dredging operations were capital incentive, there was a need to secure large tracts of mining land to cover costs. The company had acquired extensive tin land in Perak and Selangor in the FMS and setting up dredges and power stations.[21] Dredging was successfully carried out as YGC had an added advantage of advance knowledge and long experience as dredging technology was used in prior gold mining activities in Yukon and California.

However, it proved to be very difficult to consolidate large tracts of land in the tin areas of Perak and Selangor as the British had since fifty years ago granted private leases in individual blocks with different expiry date of leases. There were times when applications had to be made to convert agricultural titles into mining titles other than dealing with problems of native squatters and accommodating them into alternative quarters. There was also a question of providing bonds amounting to S$25 000 - a condition imposed by the British government (mainly the British Resident) to ensure environmental protection.[22]

As Ampang (which is part of the capital city of Kuala Lumpur today) can be considered to be one of the main centres of Chinese miners, its mines had a long history of violent strife between two rival secret gangs involving Malay chieftains. Several blocks of land were either owned or leased out to different Chinese individuals. Again, during the tin prospecting exercises YGC was able to overcome difficulties and by the end of 1922

had successfully consolidated several of the Chinese meant "*The Starry Flag Company*".[23] Both the representatives of YGC, Munro and Newsom managed to secure mining leases for large tracts of land. As noted above, this was achieved with difficulties and long months of correspondence between the various local authorities.[24]

By 1920, options were secured in Kinta District on properties near Tronoh and Kampar and in Kuala Lumpur on properties near Ampang and Salak leading to the formation of two subsidiaries, YGC Kampar, Perak and YGC, Ampang, Selangor. The acreage in Ampang was equivalent to 1,130 acres slightly more than the 1,052 acres in Kampar.

The area finally selected after the acre drilled was less than half of what was initially prospected - demonstrating the considerable amount of work put in before the final acres were selected. Refer to Table One.

Table One

Acquisitions in Kinta & Kuala Lumpur - 1920

District	Acres Drilled	Acres Selected	Yardage	Metallic Tin (lbs)*
Kinta (Tronoh & Kampar)	3,079	1,052	67,247,000	40,715,000
Kuala Lumpur (Ampang & Salak)	2,734	1,130	58,880,000	34,400,000
Total	**4,236**	**2,182**	**104,762,000**	**75,115,000**

*estimates

Source: Special Report YGC, 1920

These high-risked acquisitions both at Ampang and Kampar were seriously questioned as in these areas the high-grade the ore was embedded in tenacious clay and also due to the extremely irregular limestone bedrock beneath. This clay retains a considerable percentage of valuable ore even after several attempts of improved mining methods. The operation of the first dredge was able to achieve a technological breakthrough. Later on, persistence saw greater results when extensive modifications effort on the

dredges bore fruit turning the Ampang and Kampar mines into very profitable venture for YGC.

Dredges: Modification and Reinvention

YGC acquired their first property near Tronoh, Perak, in 1919 and constructed their first dredge which went into operation in October 1921 and this equipment included an electrically-driven dredge, a steam turbine generating plant, a machine shop and a supplemental plant. Power plant equipment using hydroelectric equipment from Klondike was readily available; however, there was need for modification to suit the Malayan condition. With the ready availability of power supply, the company was now able to operate its dredges at a low cost.

In the same year, an experimental department was set up for testing purposes mainly seeking ways and means to improving the method of saving tin and dredging capacity. This was achieved when staff of experienced men from every department at the Alaskan operations was transferred to Malaya. By December 1922, the experimental department had spent US$100,000; and a new experimental plant was established on YGC's holdings in Kuala Lumpur for the main purpose of carrying out further tests and experiments which would help decide the ultimate equipment. The result of various test and experiments were applied to two dredges brought in for use at Kampar and Kuala Lumpur from the Alaskan operations.

The Kampar dredge was built by the Bucyrus Company which was used at Klondike since 14 September 1908. After World War One, the dredge was dismantled and shipped to Malaya where it was rebuilt and stationed at Kampar was placed in operation early in July 1923. It was the first dredge in Malaya to be equipped with jigs. The Kampar dredge operated in an area which contained a large percentage of tough, sandy clay which was difficult to discharge from the buckets and was also difficult to break up and free the tin ore. On account of troubles with clay both the yardage mines and the recovery were low; less than 60 per cent of the values indicated of the boring result. The boreholes showed the presence of clay which was hard to was but it was not anticipated that the clay would be so difficult to handle in large quantities and the equipment was not properly designed to deal

with it. As such, this dredge experienced continuous delays in operation due to the difficulty in treating the tin-bearing clay.

Numerous changes were made to the equipment to improve the recovery. This changes involved considerable lost time and the dredge suffered under the handicap of being operated as an experimental machine. However, as a result of the experimental work, the clay can be successfully dealt with in desired quantity. There was notable improvement in the recovery of tin and in operating profit now that the dredge had been changed to meet the local conditions. Again, this dredge was among the first in Malaya to be equipped with clay extractor, puddler, and log washer.[25] The tin recovery has been greatly improved by the introduction of additional equipment to treat the clay and the digging capacity was enlarged by increasing the size and changing the shape of the buckets.

By 1923, two electrically-operated dredges were completed and were equipped with the new tin concentrating system in which classifiers and jigs were used instead of the old Malayan type table. This system had much greater capacity and flexibility than the table system, as there was "close saving" of tin.[26] The dredges with an attached concentrating plant advanced the technology of the Malayan tin industry.[27] The treatment plant was patented by Norman Cleaveland, an American dredge man. This dredge had 2,000HP installed and was able to handle about 750,000 cubic yards per month at cost of 110 cents (US) per cubic yard.[28] YGC's technological innovation allowed for increased capacity, good recovery of tin and most importantly, lowering of production costs.[29] By 1927, YGC dismantled and shipped four dredges into its Malayan mining operations - three from Yukon and one from California.

YGC provided technological leadership through the diffusion of latest innovations in dredging technology to other dredging operations in Malaya. The flourishing tin mining industry in Malaya attracted Californian gold mining entrepreneurs to Malaya. One such company was Yuba Construction Company - later named Yuba Manufacturing Company - the company that designed and built YGC's dredges. (Refer to attached advertisement in Figure One). Newton Cleaveland, the Chief Operating Officer had sent out dredging

engineers to investigate opportunities in providing the technology needed to upgrade the standard of the tin mining industry. This highlights the indirect role played by YGC in extending these services to other tin mining companies.[30] In 1930, two new dredges together with technical management - engineers associated with Yuba were supplied to Anglo-Oriental (Malaya) Ltd, a subsidiary of Anglo-Oriental Mining Corporation (in 1925 known as London Tin Corporation). One of them was Norman Cleaveland (son of Newton Cleaveland) who participated in the erection and initial operation of the two dredges.

One of this American dredges was the first dredge in Malaya to reach a digging depth of 100 feet below pond level.[31] Another engineer was Gerald H. Hutton, a New Zealander who emigrated to California to participate in the gold dredging industry. Hutton was then appointed as the General Manager at the Ipoh headquarters of Anglo-Oriental Malaya. There was also another American, W.M. Warren who worked for Anglo-Oriental since 1930 and was later elected Chairman - upon retirement - became the Managing Director of the London Tin Corporation in London.

It was clear that when YGC divested into tin mining in Malaya it provided opportunities for other American firms to establish business in Malaya but also in the process establish technical and managerial support for existing mining companies as proven above when American managerial and technical expertise played a part in the initial establishment of Anglo-Oriental Malaya which in the 30s consolidated into large British tin conglomerate.

Financial Resources

YGC's success in surmounting the problems presented above was due to the accessibility of financial resources. YGC had constant support from the Yukon-Alaska Trust.[32] The trustees, mainly officials and directors of YGC, were the main creditors and major stockholders with wide discretionary power pertaining to matters involving the properties, borrowing and lending money, investing in trust funds, acquisition and development of new sources of profit. In 1920, the Yukon-Alaska Trust had consented to $US1,000,000 to be used in the development of the Malayan tin and Mayo

Silver-lead projects.[33] By November 1921 YGC spent US$1.2 million increasing to US$2.15 million in December 1921 due to the acquisition of properties including installation of dredges and other equipments needed prior to the operation and production process. Funds also came from the returns of YGC properties and Yukon-Alaska Trust which owned 80 per cent of YGC.

In addition, the Malayan Tin Project received another boost when the Board of Directors agreed to release US$800,000 for further expenditure to be met by both the resources of YGC and the Yukon-Alaska Trust, YGC was not only able to secure large areas of tin but was able to deliver technological breakthrough due to new sources of financing, readily available to them. This extensive program of expansion into new fields has been made possible awing to the relationship between the YGC and the Yukon-Alaska Trust and to the cooperation between the Management of the Company and the Trustees of the trust in furthering in investments.[34]

Despite the above funds, YGC was still facing financial difficulties, as funds were needed to complete the acquisition of properties and the installation of additional dredges and power plants to successfully carry outs its venture in Perak and Selangor. There were unexpected difficulties and time was needed to localize the dredging technology to suit Malayan operation and as such in the initial stages profitable operation was eluded. Fortunately, Guggenheim Brothers came to the rescue by agreeing to assume responsibility for whatever sums that might be required by the company to complete its program as then outlined. On 15 January 1924, an agreement was undertaken between Guggenheim Brothers, YGC, and Yukon-Alaska Trust to provide a guarantee that would enable the company to borrow on a favourable terms over two years from the bank for the amount of US$1.5 million. With the availability of financial resources, YGC was able to commence its operations; and in 1924, profits from its Malayan tin ventures were finally realised.

YGC too secured additional funds when it employed the tribute system for its small areas containing good values in tin, however, due to several

reasons including isolation from dredging areas, to shallow to the ground to be dredged, these areas was leased to Chinese small operators under a royalty arrangements.[35] Income from tributors proved to be good and the first was reaped in 1926 as seen from Table Two.

Table Two
Income from Tributors 1926-1934

Years	Net Profits ($US)
1926	60,529.82
1927	60,053.39
1928	n.a.
1929	44,172
1930	91,135
1931	44,712
1932	13,712
1933	25,518
1934	68,040

Source: Annual Reports YGC 1926-34

The availability of financial resources allowed YGC to continuously modify, reinvent and maintain the dredge\s brought in from Yukon and California to adapt to the Malayan conditions and at the same time to save production costs. In shorts, as can be seen the transfer of dredging technology was a rather complex one. However, despite the challenges imposed, YGC was able to overcome them due to its managerial expertise and past world-wide experience and exposure in the mining industry.

YGC's Performance: the Interwar Years

As discussed above, YGC suffered losses in the early years of their venture. In 1923, the company encountered losses amounting to US$23, 796 due high working costs that exceeded production. When dredging operations in

Yukon and California ceased in 1923, YGC's holdings in Malaya were among the main holdings aside from the Nevada lode mines and Mayo silver-lead properties. In August 1923, a subsidiary corporation, the Ampang Company Tin Limited (henceforth ACTL) was formed and it took over the entire acreage of the Ampang-Salak project amounting to approximately 3,900 acres.[36]

By 1924, operating gains showed mush improvement as initial problems encountered were solved. There was a gain of US$315,923 when production US$908,132 exceeded working costs US$592,209. In 1925, two dredges were operating in Kampar and Ulu Klang, and by the end of the same year loans taken were fully paid and expansion programs could be funded out of the earning from its operations which began to show substantial gains of US$551,766. This was due to the steady price of tin and excellent production of tin, despite numerous engineering problems. By 1926, two additional dredges were completed and were used for mining in early 1927 in Kampar, and Ampang. Both these dredges belonged to Ampang Tin Company Limited (henceforth ACTL), a subsidiary of YGC which owned 88 per cent interest. The ATCL was also operating an open-cast mine utilizing excess power from its central power plant at Ampang.

As tin ore is a non-renewable resource, depletion must be offset by further improvement in production methods or through the acquisition of new mining sites. Hence, both these steps were taken by YGC. YGC actively sought new properties and in 1927, despite examination and investigation, none were found to be suitable. In 1928, all four dredges were utilised, the company was able to make substantial gains and the net operating profit of the four dredges was US$926,197 whilst profits from tribute and open casts operation were US$111,329, making total earnings of US$1,037,527. In 1929, more tin was produced at a lower cost, however, due to lower tin price at an average of 44.02 cents, dredging profits were reduced to US$928,999 as compared to US$1,037,500 for 1928 when tin price were higher at an average of 48.14 cents. Refer to Table Three.

Table Three

YGC's Income: 1923-1927

Year	Production ($)	Working Costs* ($)	Operating Gain ($)	Tributes ($)	Total ($)
1923	272,205.39	296,001.86	(23,795.47)	Nil	(23,796.47)
1924	908,132.97	592,209.33	315,923.64	Nil	315,923.64
1925	1,082,088.28	530,322.00	551,766.28	Nil	551,766.28
1926	802,119.86	502,951.73	229,168.13	60,529.82	289,697.95
1927	1,564,455.94	799,328.43	765,127.51	60,053.39	825,180.90

*Working costs includes duty, freight, smelting and royalty charges.

Source: Annual Report YGC 1923-27.

YGC continued in 1929 to look for new properties in Malaya when its subsidiary Elkoro Mines and Keno Hill Ltd. were near exhaustion. There was stiff competition in Malaya at this time owing to high prices and abundant capital and only in the late twenties YGC was able to test several tin dredging properties which warranted acquisition and it was known as Malay States Tin Limited (hereafter MSTL), which was financed by ACTL funds and partly by loans from YGC. This company was incorporated under the law of FMS in May 1930 with a capital S$3,000,000. MSTL, as a new company, purchased properties in Kinta Bharu in Perak and Gombak near Kuala Lumpur.

By 1931, YGC owned or controlled

A. 100 per cent of Malay States Tin Ltd. (MSTL) engaged in tin mining in Malaya. MSTL, in turn owned:

1) 88.2 per cent of The Ampang Tin Company, Ltd. (ATCL).

B. 59.9 per cent of Elkoro Mines Company, a corporation engaged in gold mining in Nevada. Elkoro Mines Company in turn owned:

1) 96.6 per cent of North Star Mining and Milling Company, Ltd., a company formerly engaged in gold mining in Nevada, now exhausted.

2) 90.4 per cent of Jarbridge Gold Mining Company, Ltd., a company

also formerly engaged in gold mining in Nevada, now exhausted.

C. 77.9 per cent of Keno Hill Ltd., a corporations owning silver lead property in the Yukon Territory, at present not active.

The Malayan operations included the operations of Yukon Gold Company (YGC), its wholly-owned subsidiary in the form of MSTL; and the operations of ACTL. Although YGC derived greater operating profit in 1931 through its interest in the Elkoro Gold Mines as compared to its Malayan operations, the Malayan venture remained as YGC's most important undertaking. As such, the future of YGC relied upon the future of tin. By 1932, Elkoro Mines was closed down due to exhaustion and the Keno Hill lead and silver property was shut down indefinitely. YGC's priority to expand mining operations in Malaya paid off as by 1933, their operation was entirely confined to tin production in Malaya, as such the outlook of tin was now of greater importance to YGC.

YGC and the Restriction Years

In February 1931, in an attempt to regulate production and consumption of tin government of Bolivia, Nigeria, Malaya, and Dutch East Indies, the four, major tin producing countries representing 87 per cent of the world's tin production entered into an agreement. An International Tin Committee was formed to impose a compulsory production restriction. Under the International Quota Scheme, each of these governments would limit both production and export of tin according to the allocation of quota. The basis of the control was the 1929 output, and the total output for each country was as follows: Malaya 37.9 per cent, DEI 20.6 per cent, Bolivia 23.6 per cent and Nigeria 5.3 per cent.

During the early months of the year, all operators were allowed to produce 75 per cent of their rated capacity. Restriction not only limited new investment but also led to the merger of existing mining companies (mainly British), though, the trend toward commodity cartels was established earlier. Anglo-Oriental Malaya Ltd. For instance, by the end of 1928 controlled fifty tin mining companies in Malaya, Nigeria and Bolivia worth about £7.25 million with a market value of £10.5 million.[37] By 1937, Anglo-

Oriental Malaya, produced one-third of Malaya's tin output whilst. By 1937, Anglo-Oriental Malaya, produced one-third of Malaya's tin output whilst YGC, as a single entity, contributed 3 per cent.

For YGC too, the restriction had curtailed further mining investment. YGC being the sole American entrant did not have the choice of a merger, as such, had to look for other solutions to limit the effect of restriction and were quick to find several solutions to counteract the adverse output conditions. Among others were allowing its recent-acquired properties to remain unequipped until 1935; reducing the amount of tin produced to 75 per cent; and most importantly instituting a prudent move to curtail the operating program of the dredges. All these steps were taken with a view to converse ore reserves for the realization of better prices. YGC too, adopted other cost cutting measures throughout 1930 and 1931 including retrenchment of personnel, however, maintaining the nucleus of the organization.[38]

Due to owner production and lower tin prices in 1930, there was a decrease in profit of US$470,087 with total combined operating profit from US$1,104,371 in 1929 to US385,863nin 1930 of which the YGC earned US$705,620 and the ATCL earned US$398,751. This loss was also due to dividends on stock of the ATCL which was received by its new wholly owned subsidiary MSTL. Due to this curtailment, reduced output led to an increase in unit costs of production as compared with 1929. This however, does not reflect operating efficiency. In 1931, despite extremely low tin prices and heavy restrictions, YGC managed to have an operating profit through at a very much lower rate amounting to $37,694 as compared to $32,849 for subsidiary, ATCL. This reflected the managerial efficiency of the organization.

In June 1932, however, the various governments concerned implemented further drastic restriction. As a result to the measures then taken, production was finally brought below consumption. During the balance of the year, world tin stocks had declined, and by the end of December, the price and heavily-curtailed production at an average of 30 per cent capacity and the working of low grade ground, the company was able to produce profits in

1932 as reflected in Table below. The recovery of tin prices from £227 per ton in December led to increase in profits. During this year too, YGC paid Pacific Tin Corporation, US$975,000 on the principal of its indebtedness to that corporation. Refer to Table Four.

Table Four

Operating Results of YGC and ACTL 1929 - 1933

Year		Net Value of Production (US$)	Total Cost (US$)	Net Operating Gain (US$)	YGC's Interest
1929	**YGC**	1,405,700	700,070	705,620	705,620
	ATCL	716,100	317,350	398,750	351,700
1930	**YGC**	833,100	565,830	267,260	267,260
	ATCL	333,980	215,380	118,600	104,600
1931	**YGC**	259,900	208,430	51,470	51,470
	ATCL	131,300	103,900	27,420	24,180
1932	**YGC**	251,770	210,420	41,350	41,350
	ATCL	102,970	86,300	16,650	14,690
1933	**YGC**	781,300	520,300	260,990	260,990
	ATCL	175,500	102,680	72,820	64,230

Source: Annual Report YGC 1930-33

In 1934, YGC's profit amounted to $711,759 based on its production of 1,016 long tons, or approximately $700 per ton. The cost of a ton of refined tin C.I.F. New York was $482 ($0.2152 U.S. per pound) as cited in the YGC Report. The average price per pound for tin at New York in 1934 was $0.5219 or $1, 169.00 per long ton. As such, YGC made a profit of $687.00 per ton, or 142 per cent over cost. This estimation was much higher as compared with 86 per cent estimated in the report of the American Consulate, Singapore which was based on refined tin C.I.F. London. Despite, the difference in percentage the main argument here is the profit made by YGC through saving in production costs.

YGC's profit for 1932 amounted to $61,746; for 1933, $284,131 and for 1934, $711,759.[39] The recovery in tin prices in 1933 and 1934 when consumption exceeded production led to increase in profits. The world's output of tin increased from 85 000 tons in 1993 to 108,000 tons in 1934 increasing further to 138,000 tons in 1935 due to the excellent prospects from the canning and automobile industry. It was clear then that YGC was among the cheapest of the producers achieved through adequate cash resources and their determination in finding solutions towards dredging possibilities in lowering cost of production.

By May 1938, its activities were confined to tin mining in the FMS and the company went through a name change from YGC to Yukon-Pacific Mining Company. However, this was not to last as on 21 November 1939, YPMC acquired a new name Pacific Tin Consolidated Corporation in the process acquiring all the assets of Pacific Tin Corporation which was then dissolved. Figure Two shows the location of Pacific Tin properties in The FMS before World War Two excluding the Berjuntai Property which was acquired post World War Two.

The business of the corporation remained to be entirely tin mining in the Malay states. The International Tin Agreement was extended for another three years until the end of 939. YGC continued to operate on restricted schedule. The outbreak of the European war in September 1939 led to an increase in demand for tin. As such in 1940, the corporation operated all five dredges at full capacity. The war with Japan began in December 1941 and when the Japanese occupied the FMS the mines of YGC and its subsidiaries had to be evacuated. The properties and their equipment fell into Japanese hands. Mining operations ceased during December 1941 and remained suspended throughout the years 1942 to 1945.[40]

Conclusion

Early foreign direct investment in Malaya tin mining occurred due to a shift in location of tin mining - the exhaustion of tin mines in Cornwell and Australia. For YGC it was the exhaustion of its gold mines in Yukon, Alaska and California. With the availability of mining equipment - dredges - and

technical expertise and with its global mining experience, YGC came to invest in Malaya post World War One. YGC's investments in Malaya were not without difficulties. YGC not only had to deal with the local British colonial bureaucracy but also with the different local environment. From the cold arctic to the warm topics, YGC's persistent R & D effort in dredging technology provided solution towards the problems presented by the different environments. The emphasis on finding a solution and the risk element was prevalent in this organization - motivated by ready access to financial resources.

Despite being a latecomer, YGC portrayed the ability to adapt American methods and technology to local conditions. The progressive upgrading of the dredges allowed for improvement in production methods leading to lower production costs and, most importantly better saving of tin. During the interwar years YGC's performance in this tin venture was market more by profits than losses and in the thirties became their sole venture. The adoption of these innovation technological developments by other mining firms contributed towards the success of dredging technology in the mining fields of Malaya. This case study highlights the importance of technological advantages in a resource-oriented foreign direct investment and how a firm's entrepreneurial efforts in R & D spread innovations across borders.

Notes and References:

1. Lewis Leigh Fermor, Report upon The Mining Industry of Malaya, (Kuala Lumpur, 1939) p. 72.
2. J. Sig. D. Rawling, 'French Enterprise In Malaya', JMBRAS, 39 (1966), p. 73-4. The Chinese for instance, were able to control their employment of labours embedded in the "truck system", clan system and secret societies. The only European mining company that had successfully ventured into tin mining was the Societe de etains de Perak, a French company. This company attempted to avoid labour problem by hiring Tamils but found them not as efficient as the Chinese.
3. Wong Lin Ken, The Malayan Tin Industry To 1914: with special reference to the states of Perak, Selangor, Negeri Sembilan and Pahang,

(Arizona: The University of Arizona Press, 1965), p. 146-9. See also, K.G. Tregonning, 'A brief account of the first seventy-five years of The Straits Tin Trading Company Limited', JMBRAS, 36 (1963), p. 83-4.

4. Yip Yat Hoong, The Development of the Tin Mining Industry of Malaya, (University of Malaya Press: Kuala Lumpur, 1996), p. 97-99.
5. Francis Davis Birch, 'Tropical Milestones: Australian Gold & Tin Mining Investment in Malaya and Thailand 1880-1930' (M.A. thesis, University of Melbourne, 1976), p. 81.
6. Jean Francois Hennart, 'Internalization in Practice: Early Foreign Direct Investments in Malaysian Tin Mining', Journal of International Business Studies, Summer (1986), p. 135.
7. Yip Yat Hoong, Tin Mining Industy of Malaya, p. 97-9. See also Wong Lin Ken, The Malayan Tin Industry, p. 143
8. By 1990, this techniques was examined by gold producers from all over the world including British and Americans who congregated at New Zealand to cash in on this new technology.
9. James W. Gould, The United States And Malaysia (Cambridge, 1969) 72. However, the first tin bucket dredge was brought into Penang by an Australian company, Tongkah Harbour Tin Dredging Company in 1907to work at a concession granted by Siam government at Tongkah Harbour, Phuket. (See, Jennifer w. Cushman (ed. Craig J. Reynolds), Family and State: The Formation of Sino-Thai Tin Mining Dynasty 1979-1932, Singapore: OUP, 1991), p. 69-71. See also, T.A. Miles, Diamond Jubilee of Tin Dredging, Tin International, January 1967, p. 3-7. T.A. Miles, World's First Tin Dredging Facing Failure?, Tin International, February 1967, p. 31-8 and T.A. Miles, The World's Tin Dredging start Building, Tin International, March, 1967, p. 70-3.
10. Yip Yat Hoong, Tin Mining Industry, p. 134.
11. John Thoburn, Multinationals, Mining and Development: A Study of the tin industry, (University of East Anglia: Gower Publishing Company Ltd, 1981), p. 42. It should be noted that dredging remained only as one of the mining methods due to its technical limitations.
12. John Thoburn, Multinationals, Mining and Development: A Study of

the tin industry, (University of East Anglia: Gower Publishing Company Ltd, 1981), p. 62.

13. Hennart, 'International in Practice', p. 138.
14. Yip Yat Hoong, Tin Mining Industry, p. 158.
15. The Guggenheim Brothers were actively involved in the development of minng properties worldwide. By the onset of First World War, the Guggenheim controlled 75-80 per cent of the world's production of silver, cooper, and lead. These strong financial connections assisted YGC in their Malayan mining ventures. See, The Guggenheim: An American Epic (New York: William Marrow and company, 1978), p. 109 - 134. See also, Thomas F.O. Brien, 'Rich beyond the dreams of avarice: the Guggenheim in Chile', BHR, 63 (1989), p. 122-160.
16. In Selangor, they filed for a prospecting license covering 85 acres of land in Batu Mukim, and a prospecting license field at the Ulu Langat District Officer for over 500 acres at Mukim Ulu Langat and Cheras in July 1920. Selangor Secretariat Files, 3940/20, 25.7.1920.
17. Mr. C.H. Munro spent four month in Malaya from January to April 1920 investigating the mining conditions and reviewing the details provided by YGC engineers. Special Report YGC 1920.
18. In support of their application, they attached a letter from the Minister of Interior, Canada addressed to the Chief Secretary of the FMS in May 1920 signifying the good relationship between the company and the Canadian government and their business acumen in the mining ventures at western Canada. Selangor Secretariats Files, 3822/1920, 29.5.1920.
19. An American named Bailey applied for all mining rights in the states of Terengganu from its ruler, Sir Franks Swettenham, the High Commissioner for the FMS, however, warned the Ruler against granting the concession. Tareq Abd. El-Hamid Ahmed Amin, 'Anglo-German Rivalry in the Malay Peninsular and Siam, 1870-1909", (Ph.D. dissertation, University of Malaya, 1995), p. 271.
20. Mira Wilkin, The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970, (Cambridge, Mass: Harvard

University Press, 1984), p. 109.

21. G.E. Greig, Mining In Malaya, (London: Malay States Information Agency, 1924), p. 42.
22. K.L.O 505/19, 'Application for permission to purchase plans 24089 to 24105 South of Siputeh - Mukim Blanja, 30.7.1919', K.L.O. 37/20, 'Application for prospecting license onto plan no.s 13473 & 1929 area about 62.1.35 in Kampar mukim', 22 January 1920, K.L.O., 37.20, 'Application for prospecting license onto plan nos 13473 & 1929 area about 62.1.35 in Kampar Mukim', 21.12.1920 and Selangor Secretariat, 5223/1922 (encl.), 'Agreement made by YGC with the British Resident in Perak dated 25.5.1922', 1922.
23. Selangor Secretariat Files, 5481/22, 'Status of the Yukon Gold Company's Holdings in Selangor', 1922. See also, Norman Norman Cleaveland, Bang! Bang! In Ampang: Dredging tin during Malaya's emergency (San Pedro, California: Symcom Publishing Company, 1973).
24. Both Munro and Newsom in their attempt to secure prospecting and mining leases and to prove their standing had on the 28 June 1919 written to the Warden of Mines, Batu Gajah, Perak. In their latter was stated that they were representing the YGC of NY - an equipping and operating company of one of the strongest old dredging companies in America which was operating on a large scale in the US and Canada for the last twelve years. They mentioned that they had already secured options from private leases and hope to consolidate several blocks of sate land to warrant for successful dredging operations.
25. Norman Cleaveland, 'The most travelled Dredge in the World', Malaya in History, 5, (1959). p. 26-7.
26. Annual Report YGC, 1923. See also, Selangor Secretariat Files, 5481//1922, 'Status of the Yukon Gold Company's Holdings in Selangor', 1922.
27. Wilkins, Maturing of Multinational Enterprise, p. 109.
28. For details, see, Cleaveland, Bang! Bang! in Ampang, p. 39.
29. Annual Report, YGC, 1925.
30. The Yuba Construction Company co-owend by Newton Cleaveland

and W.P. Hammon had operated the first successful gold dredge in California. See, Samuel P. Johnston, Gold Dredges: The Part played by the Yuba Manufacturing Company in the Great Romance of dredging for placer gold, platinum and tin, (San Francisco: John Henry Nash, 1927).

31. Cleaveland, Bang! Bang! in Ampang, p. 43-5.
32. The Guggenheim Exploration Company owned 2.8 million shared of the 3.5 million capital stock of YGC. This company had instituted proceeding for dissolution in 1916, turning over its entire holdings too the Yukon-Alaska Trust. Annual Report YGC 1915.
33. Special Report To Stockholders, YGC, 10 December 1920.
34. Ibid.
35. In the early days, when the Chinese had the right technology and a mush more efficient organization, some Western firms employed Chinese under the tribute system when the owners were the main shareholders supplying capital and equipments needed whilst the Chinese being the minority shareholders worked the mines. A certain percentage of profits goes to the mine owners and the balance to the Chinese mines.
36. Annual Report YGC, 1923
37. Birch, 'Tropical Milestone', p. 231.
38. Annual Report YGC, 1931.
39. RG59, State Department, 1930-1939, 846d.6354/50, AVC-Singapore, June 12, 1935, On Tin Restriction
40. Annual Report PTCC 1941.