**ABOUT FORAD - A Short History**

**Early development:**

Development of FORAD by Professor Remmers began at INSEAD in the early 1970's stimulated by two related events: on the demand side in the form of a new MBA course on corporate finance in multinational companies; and on the supply side provided by the arrival at INSEAD of a Hewlett Packard mainframe computer connected to computer terminals. Although case studies were widely used in finance courses, Professor Remmers believed they were inadequate to teach the realities and complexities of managing currencies and financing a firm with operations in several countries.

Trading was among the various units of a multinational group and with third parties. Funds could be raised in one country in order to finance an operation in another. This gave rise to currency risk, tax, and accounting issues. A decision to manage these in one unit would have repercussions in other units, and with a typical case study, the overall outcome was not necessarily obvious.

A second shortcoming of a typical case study was the time dimension. A decision taken in time t would have an influence on decisions in time t+1 and after; this is obvious in real life, but impractical to simulate with a classic case study. From this, the idea of an ongoing case study using a computer simulation appeared to offer a solution. The effects of a decision in one period had to be lived with in subsequent decision periods. And to capture the interest of students, competition needed to be added to provide stimulus. Hence several companies or teams would each try to maximize some goal such as profit or share price. The idea appeared interesting, but its execution would only be possible with a computer.

**Computer terminals:**

With the arrival of computer terminals connected to a main frame, a multi-period simulation now became practical. Students could work as a team using a terminal to input their decisions and see quickly the results. In this format, FORAD was used for 2 or 3 years at INSEAD, in bank seminars, and in a handful of business schools in the US including Thunderbird, and in Australia at MacQuarie University. In the beginning, the code was written in basic. The INSEAD mainframe was soon upgraded and the new equipment was able to use fortran, a more powerful language at the time.

The problem of using a mainframe was that it was cumbersome and risky. If a mainframe was not available at the site where FORAD was being played, a remote connection was possible - the players’ terminals were connected to the mainframe by fixed-line telephone. But this presented enormous headaches. To start with it was very cumbersome. One would put a special handset into a cradle, dial the number, and wait for a tone indicating connection. This worked indifferently. And this system was risky. An example was when it was used in a seminar for a major Swiss bank which took place in a conference center outside of New York City. The terminals at the center were connected to a mainframe located at NYU in Manhattan. Three decision periods went reasonably well, but when running the results for period 4, lightning struck the transmission line at NYU knocking out the system for a couple of days, enough to cause the simulation to be abandoned. The disaster had a silver lining however. PC’s were just beginning to become widely available. The bank was so pleased with what they saw in the aborted simulation that they proposed financing a PC version of FORAD.

**FORAD on a PC:**

This led to the next phase of FORAD’s development at the end of the 1980's. With the bank providing financing, a professional programmer in the US converted the mainframe fortran code into a version suitable for a PC with a hard disk drive. Each player team got a floppy disk with the files needed to run FORAD, to take decisions and see the test results on the PC screen. This was similar to the current version, but the screens were only in black and white or LED orange and processing was very slow due the limitations imposed by the early PC’s. Each period’s results were processed by the game administrator as they are still done. Usually the output was printed on a "high speed" printer in several copies for distribution to the players. Lots of paper being consumed with scant regard to cost and ecological concerns. The most important aspect of this phase of development was that the simulation was now decentralized - a mainframe no longer was needed. But this version was cumbersome, slow, and lacked many features, not the least color screens.

The current version of FORAD began to be developed about 1991. At the end of the INSEAD MBA finance course using FORAD, an Israeli student who took the course proposed to "modernize" it. His wife was expecting their first child towards the end of that summer and they wanted the child to be born in France. The proposal suited us both since he wanted to earn some money and I was interested in a talented programmer who already knew FORAD and had good ideas for its improvement: color screens for both input and output, adding help messages, improving speed of seeing results, building in various safeguards to try to minimize risk of losing decision data, otherwise making it easier to use. At the same time the players’ and administrators manuals were improved in order to help get students up to speed quickly. This version still used fortran as the principal code to process the results. But for what players saw, for decision inputs and output of results, turbo pascal language was used. With this kind of hybrid structure, inputs were stored in a temporary file until the run command was made. Then this file was read by the fortran model, the data processed and then returned to the players’ file to produce output. Not especially efficient. At the beginning, due to relatively slow processing capabilities of PC’s in the early 1990's, the time from input to output was several seconds. But as PCs became faster, and especially with the USB key replacing the floppy disk, this delay dropped dramatically to the also instantaneous response enjoyed today.

**Modifications and challenges:**

FORAD has been almost always a work in process. The three currencies in the early versions were sterling, deutschemarks, and the dollar. With the advent of the euro at the end of the 1990's, the German subsidiary adopted the euro and the British subsidiary was replaced by the Japanese using the Yen. The early versions did not have options, swaps, company credit ratings, tender sales, variable rate loans, share buybacks, convertible loans, or raw materials such as oil. Markets for options, swaps, and interest rate futures scarcely existed in FORAD’s early days. As these became standard instruments in practice, they were slowly added. As those of you playing FORAD have found, hedging interest rates or using swaps did not provide dramatic results like hedging [or speculating] with currency options or oil futures. To be more challenging and useful [for FORAD players] swaps will need some improvements such as for example being able to swap dollar debt for yen debt. This idea was postponed because the complexity it seemed to involve. Credit ratings with their impact on the cost of debt were added to try to address the problem of players borrowing excessively. However, debt was always available to FORAD companies if at an ever-increasing cost. Since this is not realistic, an absolute cutoff of credit should have been implemented. Or a requirement to sell off assets or issue new equity. Perhaps this will be addressed in FORAD 2.

Another problem that we struggled with constantly was scoring performance. Maximizing share price seemed to be a legitimate objective function. This raises a number of issues. To reduce complexity and avoid creating a black box situation, it seemed reasonable to define share price as the price/earnings ratio multiplied by the consolidated earnings per share. With care, serious players can have reasonable control in managing the EPS: avoid dilution of equity, borrow cheaply, keep inventories and receivables under control, and avoid excess production capacity, among other actions. But they could also speculate by leaving currency positions unhedged or partially hedged, or by taking long or short positions with options or futures. With luck, they could enjoy very large profits which would be reflected in a higher share price. Or they could suffer bad luck and see their share price collapse. Either scenario would have repercussions that could be reflected for several periods and possibly damage the learning process for the lucky speculators as well as for the other firms that did not enjoy good luck. Over the years using FORAD I lost count of the number of times I heard complaints such as: "Company 3's players are crazy. They speculate constantly. They were lucky to guess the direction of the dollar and took huge positions that paid off. What did they learn about managing finance in a multinational? OK they have a higher share price than those of us who took decisions carefully. But is this fair? What do they take away from their experience?"

How to discourage this kind of gaming behavior was not obvious. We tried to encourage players to manage several aspects of the game that would have a measurable impact on the P/E ratio: penalize excessive volatility from speculation; aim for a good credit rating; manage interest rates so that those obtaining the lowest effective rates would have a higher P/E ratio; reward carefully executed decisions by comparing actual results with "planned" results; encourage hedging by comparing actual exchange rate results against a fully hedged position; reward companies’ tax management. The way these elements were scored was set out in the players’ manual, but sometimes a challenge to fully grasp especially given the limited time allowed for taking decisions. There is a lot of opportunity for FORAD 2 to improve how performance is measured and rewarded. Another aspect of computer simulations is their tendency to crash. To eliminate this requires extensive testing by the designers to obtain a so-called beta version. Then testing becomes delegated to the players. This can continue for long periods. But since there are literally thousands of decision combinations possible, it can take a very long period to be confident that all potential crashes have been found and corrected. FORAD 1 probably can be considered highly stable now that it has become more or less obsolete. To get to this stage, FORAD 2 will need a lot of hands-on testing by players to identify and correct programming errors besides responding to suggestions to add or drop certain elements in the game.

FORAD thus evolved over time much as a child building a structure with legos. Things were added, modified, or dropped as we gained experience. At the same time, technology had its impact as PC’s evolved with Windows becoming upgraded constantly. With earlier versions of Windows up to and including version XP, FORAD could run satisfactorily in a DOS emulation mode. With the advent of Windows Vista and Windows 7, this has become problematical. FORAD 2, a true Windows application seems to be the obvious answer. And not only for solving the running problems. Building on the experience of many years of using FORAD at Thunderbird and elsewhere, FORAD 2 offers many enhancements besides being more user-friendly, and should make the simulation a more enriching and enjoyable learning experience.

Lee Remmers

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