

4 The Narrative Shaping of a Product Creation Process

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The promise of modern biotechnology has driven investment in research and development (R&D), in new product development and in the continuing, even if precarious, success of small (and now larger) biotechnology R&D companies. The rhetorics and dynamics of promising technologies are not limited to modern biotechnology; they may well be constitutive of modern technology (Van Lente, 1993; see also this volume Chapter Three). Future worlds are sketched as a justification for investing in technological development. Different actors contend, and do this also by sketching their particular future worlds (see, for example, Hughes, 1983). In biotechnology, the arena of contestation has been expanded to include critical professionals, consumer and environmental groups, which are concerned about the possible impacts on environment and evolution, and about the risks of genetic modification to produce 'Frankenstein' foods. These are all public or semi-public arenas. In this chapter, we focus on a biotechnology firm, and in particular on the future worlds projected through its product creation processes - the product in this case being an industrial enzyme.

Within an industrial firm, such broader issues are often relegated to Public Relations Departments. And perhaps rightly so: innovation and new product development are difficult enough in their own right, and the people working on it should not be distracted from their main purpose. The broader contestation, and the rhetorics of risk and promise (Rip and Talma, 1998), are excluded to be able to get something *done*. Biotechnology firms have, by now, learned (and sometimes the hard way) that what they get done in this way may not be acceptable, and accepted, in society. There is a new receptivity to include broader societal considerations into the decisions guiding the product creation process.

While we applaud this change of hearts, we also suspect that it may be an add-on, tacked on to the regular management of innovation, for example

by inviting a spokesperson from an environmental group for a discussion session. Even when top management is serious about these issues, such interactions may remain symbolic because there is insufficient understanding of the way promises and warnings function in product creation processes. This is why we have bracketed out these wider concerns, and focused on what we call the 'narrative shaping' of product creation processes. Only if this aspect of product development is understood and taken into account will the wider interactions be productive.

Thus, we will focus on the firm-internal processes, and highlight narrative dynamics that serve to constitute an actor's future. We will do so in general terms, by criticizing modernist stories about successful innovation. We will then present the mosaic of stories which compose the development of the industrial enzyme Gammese (the name is fictional), and continue to identify generalizable patterns. Contestation is visible, whilst remaining subdued. But the dynamics of future worlds, and their inclusion in ongoing and interacting narratives, may well be a general rather than unique pattern of future oriented organisation. On the basis of our case study, we hope to demonstrate the way in which this analysis both highlights the constitutive character of narrative whilst also critically contesting the accounts of actors who sought to explain to us how their present future came about.

Innovation Journeys and Narrative Analysis

In retrospect, the story of a successful innovation is often told in a linear way, with the first plans leading 'naturally' to the eventual outcomes. In these accounts the eventual achievement functions as a goal to be reached from the beginning, and is realized in a number of steps, the stages of a journey along the path that had been visible from the beginning. Actual processes, however, are much less linear than these retrospective accounts suggest. The metaphor of an innovation journey, with its contingencies, its setbacks and its detours, captures the real-life complexities of product creation processes much better than rational-control views (Van de Ven et al., 1989). Therefore, linear accounts will often be a simplification and distortion of a more complex process. So, is there something to be learned about the narrative shaping of a new product? Something can be learned if one realizes that accounts are produced all the time, not just after the journey has ended. There is a variety of accounts: formal and informal, technical and social, strategic and operational, for internal and for external purposes. These accounts are linked and build on each other. So one can

inquire how such accounts evolve along the journey, and why they can become more linear over time. Linearity turns out to be an outcome (albeit a precarious one) of interacting narratives, rather than a necessary feature of product development. During the journey a certain thrust and directionality can develop.

Besides linearity and thrust, interacting stories have other (narrative) effects. We use the notion of an emerging 'narrative infrastructure' to analyse the overall effect of interacting stories. Analytically, the important point about infrastructures is that they help to explain how coherence and linearity can emerge in multi-actor, multi-level processes, without any one actor specifically being responsible for it. Product creation processes are one example of emerging coherence. They might well be a specific genre with a typical form of narrative infrastructure.

We have reconstructed the actual innovation journey in the case of an enzyme, to be used as an additive in animal feed. This innovation project had its setbacks and detours, but was successful in the end. Before telling the story of how scenarios and other narratives shaped the innovation journey and built up an overall thrust and linearity, we have to develop the narrative approach a bit further, and give an account of our method of data collection and analysis (particularly, the issue of retrospective accounts).

Narrative Infrastructure

First we have to clarify what we mean by 'narrative' and how it relates to future-oriented action. Narrative occurs in interaction, it informs and shapes action, and makes action into something memorable. Narrative and (the need for) action are closely connected. Our suggestion is that agency appears only in and through narrative. In other words, narrative is constitutive of agency - instead of the other way around as is often supposed. For example, a promising story of modern biotechnology drives investments in R&D and new product development. Or, more specifically, in product creation processes, a project team is constituted and acquires space to work on product development as an effect of prospective stories: 'selling' a lead for a new product and portraying itself as the 'hero' who will be able to achieve the desired new state. Agency materializes in this way, also literally (Law, 1994; Van Lente and Rip, 1998), and an overall thrust is gradually built up. The key point for our purpose is how the contingencies, even chaos, of ongoing interactions are shown to acquire a shape, in fact a variety of shapes, through the stories told, at the time and afterwards.

We use narrative in a broad sense. The actual telling of stories, whether prospective or retrospective, whether terse or elaborated, is only one part of

our use of narrative. Narrative in the broad sense takes the material setting and the situation into account. The staging of the text of the story is an essential element of the 'story'. So, there is more to 'story' than words and a receptive listener/reader. Rather the reverse is the case: the 'story' is produced by the setting, in the broad sense, and the actions and interactions played out in and with it. The actors are not just tellers/authors or listeners/readers, but they become characters in the overall mosaic of 'stories'. The actual stories they tell are only one of the elements contributing to the evolving 'story' or mosaic of 'stories'.

It is here that our notion of narrative infrastructure comes in. On a first, and superficial, level there are terse and elaborate stories told by the actors (Boje, 1991). The teller of a story has a listener who will respond and become the author of a further story, building on, adapting and/or contrasting the earlier story - always in the broad sense, including material and social aspects. This turning of the narrative tables in ongoing interactions creates a multi-authored and always heterogeneous mosaic of stories. Sometimes, one master story evolves. What always happens is that some of the narrative building blocks continue to be taken up, become accepted ingredients, and because of their being accepted, orient further action and interaction in the setting (and across its boundaries). The building blocks and their linkages constitute a narrative infrastructure, which enables as well as constrains. When a narrative infrastructure evolves out of the stories, actions and interactions of the actors involved, actors become characters that cannot easily change their identity and role by their own initiative.

Product creation processes can be seen as one genre of overall 'story' in which novelty and uncertainty are important aspects of the setting. Actors, in fact, speak of the 'story' of the creation of the compact disc, or the personal computer. In our case study, of a biotechnology firm developing a new industrial enzyme, Gammese, actors spoke easily of the 'Gammese story', and could compare and contrast it with other such 'stories'.

Narrative Analysis

Narrative analysis of such broader 'stories' draws specifically on the narrative analysis of texts. For example, there is sequentiality (or constraints of the past, or increasing irreversibility), not just as a matter of choices being made by actors, sunk investments etc., but through an evolving narrative. The reader-author collusion (predicated on a shared culture) imposes constraints on what can be said, and similarly, the triangle of actors, setting, and narrative infrastructure enables and constrains action and interaction. In texts, for example, if character X has been introduced as

male, it becomes almost impossible to let him become pregnant. In organizational life, there are role expectations and specific cultural repertoires. And there are problem definitions and typifications, including views of what kind of product it is that must be created (which shapes the innovation journey) and views of what various strategic partners mean for the product creation process (which foreclose other options).

This type of analysis is necessary to trace the development of a certain thrust over time in the multi-actor, multi-level product creation process. In addition, typifications develop which become part of the narrative infrastructure and constitute the building blocks for an eventual master story. Successful product creation processes have 'heroes' and 'helpers' (and failures may have 'tragic heroes'), and are thus amenable to Greimasian semiotic analysis of actants in a story (Greimas, 1987). We shall follow their approach only loosely, however, because we are not limited to a written text, and some of the distinctions and figures introduced by Greimas lose their force when the story is multi-authored and interactive. In making this move from textual semiotics to social semiotics, we follow actor-network theory (Latour, 1984; Callon, Law and Rip, 1986). While some concepts of actor-network theory, like enrolment and translation, as well as some of the case studies (Callon, 1986b), suggest entrepreneurial voluntarism (and have been criticized for that), it is the interest in emerging irreversibilities (Callon, 1991 and 1992) and infrastructures (Latour, 1984, cf. also Van Lente, 1993 p.212-223) which is important here.

An example of narrative analysis of the thrust of a project and its evolving story is Van Lente's (1993) study of a failed innovation (see also Chapter Three of this volume). Particularly interesting for our purpose is his detailed tracing of prospective stories and their interaction, reinforced by assertions that the 'right' thing is being done. It then becomes difficult to say that a project should be stopped, and if such a proposal is made, it disorganizes and embarrasses actors - because their narrative infrastructure does not support them anymore. The case study concerned an innovation project aiming to develop a new isolating material, Tenax, important in the world of high-voltage transmission of electric energy, and being pushed on the basis of expectations about its potential performance. Researchers, managers and members of the board of directors told stories of progress (actual and expected) for a number of years - and rightly so, in spite of difficulties, including the practicalities of producing high-voltage cables. The effort to maintain progress became too high, however, and in the space of one month assessments were turned around. To the surprise of the Board of Directors and some external allies, the project collapsed. As if it were a house of cards - and indeed, it was a house of cards, because its strength

resided in stories that had to come true. Interestingly, the theory about the electric performance of the new material, at first presented as a robust resource, now became 'just a theory', and the research institute KEMA propounding this theory was transposed from an ally to the scapegoat, the source of failure.

Our own case study is one of a successful project, but one which was on the brink of collapse a number of times. In other words, success or collapse are not the main distinguishing variables. The underlying dynamics are more important - which leads to the question of how to reconstruct them.

Data Collection

Reconstructing narrative in a retrospective case study is beset with difficulties. Sometimes, there is enough documentation on the early stages to get a view of the variety and the contingencies at the time, independent of the reconstructions by interviewees. We were fortunate in having access to all the project team files, the minutes, notes and letters, and official documents. These data were used to reconstruct processes and interactions (Deuten, 1994), and as an input for the interviews.

A successful product creation process also makes alternatives invisible, and contingencies along the innovation journey are then seen as noise, or perhaps occasions in which the prowess of the victorious hero was shown. Trying, in interviews, to get behind such actor's reconstructions will then seem to undermine their victory. Even when interviewees do not feel threatened, there is still the effect of outcomes being known, so that events, choices and actions at earlier stages will be presented as part of a development leading toward this outcome. Interviewees will automatically introduce characterizations in terms of 'right' or 'wrong' (just as watching a play or a movie where 'seeing' the storyline enables us to identify heroes and villains quickly).

One way to obviate such reconstructions after the event is to ask the actor to time-travel, and think back to the earlier situation. Documentary data and imaginative stimuli by the interviewer help him to remember the uncertainties and contingencies that were lived through, and get him to tell about them. (We say 'him' because most of the actors in our case study, and all our interviewees were male). In this way, one can, on occasion, also see how contingencies were reduced and linearity was created by introducing narratives with a certain plot which, through being told and linked to the stories of others, became true.

Another entrance point is provided by prospective stories told at the time, from expectations and the organisation of agendas into scenarios for uses of the product and the market assessments at an early stage of the

product innovation process. Action is shaped by such stories. Documents of this kind from the project file were discussed in the interviews to find out about their setting and the role they played.

Our two main interviewees, Orleans and Bentrom (these are fictive names), were in a position to see themselves as agents, as persons who made a difference. Orleans was head of non-division R&D and responsible for pushing the project in its early phases, Bentrom was leader of the project team. Both were also natural narrators, and realized how they had been using stories to further their ends. Our method of 'time travel', putting them back in situations where we knew shifts in context or content had occurred (based on the detailed chronology we had set up using archival materials), worked well with them. We asked them to describe, not to justify (or condemn), and obtained materials showing a mix of contingency and purpose, reflecting uncertain responses to setbacks, and exemplifying how they tried to create agency and linearity. (Of course, all materials from interviews are joint constructions by interviewee and interviewer. But the construction is not arbitrary, so the result tells us something.) We also heard about the stories they consciously told as management tools, to team members and to other levels in the company (see Deuten, 1994).

In the next section, we shall present our data as indicating the evolving mosaic of stories which constituted the Gemmase project. Our presentation implies a meta-story in which a narrative infrastructure emerges, and we shall highlight the meta-story in the subsequent section.

The Gemmase Project as a Mosaic of Stories

Reduction of complexity and uncertainty is important to get a project started at all, but can, of necessity, be only tentative at that time. Management decisions and the resolve to get something going are taken, in retrospect, as the beginning of a project, but are themselves the outcomes of earlier and less clear processes. In the case of the Gemmase project, within extradivisional R&D an old idea about using the enzyme Gemmase as a feed additive (to improve the uptake of phosphates) was being reconsidered in the early 1980s. A contact person from the feed sector had told them that there might be a market for such a product. Because of the progress made in recombinant DNA technology, the production of this enzyme might turn out to be cost-effective.

Our interviewees stressed (in line with received views in innovation management literature) that a promising idea or a 'lead' must be transformed in a clear concept of the technology, the functions, the applications, and with expectations about cost of production and potential

market - all this at a stage when very little can be said with certainty. Otherwise, they said, there is no orientation of action, nor can one convince others about the value of the idea. But making a clear concept is not just a matter of listing arguments. Orlans arranged them in a story about a world where Gammese would play a role: as an essential ingredient of animal feed (reducing costs for farmers as well as reducing the environmental burden of intensive farming) and as a key element in the strategic portfolio of his company. In other words, a trustworthy start-out story is essential in the early phase of a project. The start-out story is like a scenario, made robust through linkages with scientific, technical, economic and strategic elements, as well as the credibility of its authors (for Brown, in Chapter Five of this volume, Dolly the cloned ewe is a good illustration of a poorly articulated start-out story whereby the utility and value of the event was too ill-defined to protect it from wider social critique).

Orlans, in fact, insisted on the importance, in product innovation processes, that 'there is somebody with vision and credibility, who convinces the others that this must be accepted' (note the use of 'must'). He was such a person, and without him, he said, the project would not have taken off. Orlans actually spoke of himself as a 'product champion': representing the product-to-be to the world, but with the connotation of being a fighter who turns setbacks into challenges. Such a typification is an easily available role/identity in the repertoire of management culture (and in the management literature). In his case, he presented the promise of Gammese to other divisions, staff and the Board of Directors, realizing the multi-actor and multi-level dynamics involved and playing on them.

The start-out story was reinforced and convinced the Board of Directors. Part of the R&D budget was made available by the middle of the 1980s, and a small project team was constituted. A limited *in vivo* test with a known type of Gammese was done which performed very well inside animals. However, within the company there was some resistance to the project: would there really be a market for industrially produced enzymes in animal feed? There was no way of telling directly. A pessimistic as well as an optimistic scenario existed about the future of Gammese, both of them diffuse. The project team saw its task as making the positive scenario come true. An important step had been to involve a Working Party on Digestibility of Phosphates (*Werkgroep Fosfor-Verteerbaarheid*) of the Community Board on Feed (*Productschap voor Diervoeders*). The company needed the expertise collected in the Working Party, and together, they made a detailed planning of the steps in the development and first applications of Gammese. The diffuse scenario became specified, and it was co-authored by credible actors. The content and context of the project plan convinced the Board of Directors, and the Project Team could

continue and expand. Two things happened at the same time (and are in fact two sides of the same coin): commitment and resources created a protected space for the project plan to be realized, and the Project Team became a unitary agent responsible for progress, and thus for the necessary repair work.

The project plan is an important element. It is a prospective story, setting out stages of the innovation journey. Since it is used in communication with higher levels, it is also an account before the fact, and the project team will be held accountable for deviations. The project team has to use the plan as a road map, even while realizing that the road is not there yet, and contingencies have to be faced. Finally, the project plan also allocates roles and tasks internally, and specifies linkages with external actors (within the company and outside it). It is a stylized story, with various characters and a (minimal) plot.

The project team would check against the milestones in the project plan, and work harder if these threatened not to be achieved. When such efforts failed, one had to have a good story to tell the Board of Directors. Repair work, in the small and in the large, was structured by the need to follow the plan and so to stay on course, rather than only by the need to solve concrete problems.

The relationship of the Project Team with the Board of Directors was ambiguous. The regular reporting to the Board of Directors, as well as the reporting in incidental interactions with them, has a double function: on the one hand, sharing information within the company, in particular with higher management, and on the other hand a project team saying to its sponsor we're doing (reasonably) well, please continue supporting us. It is a balancing act, as Bentrom experienced it:

It is important to communicate uncertainties to higher management, although you have to be careful there as well, in my experience. ... You should prepare them so as not to have to surprise them later. On the other hand, if you indicate too many uncertainties, they say 'this won't come to anything, this guy is so uncertain'. Or in a less personal vein, You have to steer clear from various dangerous rocks. For one thing, you should not raise exaggerated expectations. For another, you should not paint too sombre a picture, otherwise they'll scrap the project.

Clearly, this is a dialectics of promise (Van Lente, 1992). In the case of Gammese, the dialectics could profit from widely-shared background expectations about the importance of enzymes, about markets, about regulation, so that Orleans could craft a convincing story and keep the project on its course. But circumstances could change: the relationship with the Board of Directors came under pressure in the late 1980s, when the

company went through a process of strategic re-orientation. The company wanted to go back to its core competences. Enzyme production definitely belonged to the core, but capturing large slices of agricultural markets did not (even though the company had been trying to expand in this direction). Gemmase had to be repositioned to keep its support. Orlans and Bentrom successfully shed the connotation of Gammese as a commodity in the agricultural market, and convinced the Board of Directors that the company still had a role to play in this market, supplying Gammese as a specialty. The Commodity Board and animal feed firms were mobilized to support this claim.

The new story was further strengthened by emphasizing the environmental advantages of the product. Apart from the substance of the argument, there were also PR considerations. Not just for the product itself, but for the image of the company as a biotech company in a time when societal acceptability of biotechnological products was an issue. Bentrom:

For some other enzymes produced by the company it was difficult to explain whether there was a benefit to the consumer. So it was noted that it was useful to have a product that is easier to explain. But it was not developed for that reason, of course. This was an additional advantage.

At the level of the company, the Gammese project helped to tell a story about the positive role of biotechnology in society. In the annual reports, the project was regularly brought up as a good example of the contribution of biotechnology to reduce environmental problems.

This turned out to be a mixed blessing for the Project Team. As early as 1987, the Board of Directors announced to the press that the company was working on Gammese. This was four years before the planned date of introduction on the market. The Board of Directors probably did so because it could score in the media with this environmentally friendly product (the fact that it would reduce phosphate burdens in agriculture was emphasized). In Bentrom's experience, this created an enormous pressure on their project.

As far as I was concerned, there was no need to do such a thing. ... On the other hand, the advantage is that the company commits itself publicly to this project, so they can't stop it easily anymore.

The registration of Gammese was another problem that needed to be tackled, and where many actors at different levels were involved. At the time there was no relevant regulation in the Netherlands or at the level of the European Union yet, so the fate of Gammese was uncertain. Informal interaction of Orlans and others with officials of the Ministry of

Agriculture indicated that there was a possibility of ad-hoc admission. In Orlans's words:

This registration question was of course a difficult business. The Netherlands would have to risk its neck in advance of an eventual EU regulation, and defend this in Brussels. [The Department of] Agriculture has had difficulty in doing that . . . We needed Agriculture. On the other hand, it was clear to us from the beginning that Agriculture needed [Gammese] [because it would help them solve environmental problems in Dutch agriculture]. . . . We have been active politically, put forward our story there. . . . So a story had been established of [Gammese] being an interesting product.

A Director-General in the Department of Agriculture found the promise of Gammese so interesting that he arranged (perhaps after some prodding from the company) that the Minister would come and visit, and hear the Gammese story from the company itself.

So we had the whole club visiting us [the project]: the Minister and a lot of high-level officials of the Ministry. Our Board of Directors was there - that was a good thing for us, naturally - and then we told, in all its splendour, the whole story of what we thought was the role [Gammese] could play in the Netherlands, what with the environment and so on, and how far we were now with production. How we expected to have everything ready shortly, but that we needed approval, and what Agriculture was doing about this. But really, in other words, by showing off this whole story again, there was no way back. In this way, we also supported those people from Agriculture who were working on the approval, saying as it were: this must happen now, isn't it? All the big men were there, so if the people would encounter resistance, they could always say that their bosses had heard that it had gone through. All that helped.

Telling the story to the Minister of Agriculture, externalizing it as it were, created commitments internally, with the Board of Directors, with the Project Team. And Orlans and Bentrom realized this, and exploited it.

Public acceptability was also a matter of concern for the project team. Public acceptability is important for every product nowadays, and especially if it is biotechnological (Deuten, Rip and Jelsma, 1997; Jelsma and Rip, 1995). Spokespersons for public acceptability therefore are important actors to the company. In this case, the company had to convince a Consumers' Platform on Biotechnology that Gammese was important for the consumer, and that it was safe. The environmental advantage of Gammese played a key role in the stories told to the Platform.

These interactions were actually part of a longer process, in which the company had been anticipating issues of acceptability and trying to avoid problems. Orlans explained this as follows:

I have to add that this product, [Gammese], was not such a difficult product in this respect. In genetic modification, there are gradations from homologue to heterologue modification, and here everything was quite simple [because it was a homologue, i.e. less chance of unexpected effects], so we didn't have too complex things to do [for registration]. Also, we hadn't used markers or other things which could raise discussion. So we were on the safe side in this acceptability issue. [Deuten: Did you do all this intentionally?] We paid a lot of attention to it, from the beginning. Like let's not do it this way, because it will create a lot of problems for us. [Deuten: Were there negative experiences in earlier projects on these points?] Yes, we even had a kind of strategy in the company to build up acceptance very gradually, and preferably by starting with 'safe' ventures. So not go out and challenge the world, that would be too risky. [Gemmase] fitted perfectly in this strategy, otherwise we might not even have started the project. ... Of course, we had some experience with other projects. ... So you can choose the right directions. And we profited, of course, from the great advantage of the product being environmentally friendly.

Narrative Reduction of Complexity - And Its Risks

In the project planning a series of activities was formulated. First, the best Gammese had to be found in an extensive screening programme. Second, on the basis of the amino-acid sequence of the selected enzyme the DNA of the micro-organism had to be cloned. Third, a host had to be selected in which a DNA construct for over-expression had to be implemented. Finally, the production process had to be optimized. Meanwhile, application tests had to be done and a formulation of the end-product had to be developed. The planning schedule was tight, and the different activities had to be managed in a parallel way. Delays in one line of activities would cause delays in another line of activities. During the project smaller and bigger problems and delays occurred. We shall give two examples of how management dealt with these uncertainties.

A major setback, at first not recognized for what it was, was the degradation of the enzyme when the feed with which it was mixed was pelletized. The project planning came under serious pressure. A series of earlier measurements of thermal resistance of Gammese had been quite

encouraging, but now, in another set-up for making pellets, the enzyme degraded. When asked about it in one of our interviews, Bentrom said:

I think we did not want to believe it at first. [Deuten: You thought it was a measurement error?] Yes, because we had shown a number of times that pelletization resistance was good. Then you don't let yourself be thrown off balance by one experiment which indicates that thermal resistance isn't as good as you thought. So we said, let's do another experiment. As yet, there's no reason to completely change course in the project. [Reflecting:] We absolutely refused it. That is a bit of denying reality. But what if you get good results twice with an enzyme, and bad results the third time, what do you do?

There was the psychological element of having lived within the framework of a story, and not wanting to give it up, since it would mean losing your road map (Wagenaar, 1997). There was also an effort at checking the 'reality'. At the time, it is not clear whether thermal resistance might indeed change in different circumstances, or whether one might perhaps control circumstances so as to minimize degradation of the enzyme. It is only after repeated attempts and assessment of their outcomes that one decides whether to 'change course' or not. During those attempts, the original story and road map remain the guideline. Fortunately, the problem with pelletizing was gradually clarified, and other ways of adding and mixing the enzyme (originally seen as less relevant) were taken up successfully. In the case of Tenax referred to already (Van Lente 1993), things didn't turn out so well. In this case the course was changed, for some quite unexpectedly, and the story was adjusted. In both cases we see how narratives create inertia for a project team in a protected niche. For actors, such an attitude of trying to stick to the original plan can be viewed positively as tenacious, seeing setbacks as a challenge to the 'purpose', but also negatively, as reduced ability to respond to changes.

Elsewhere (Deuten, Rip and Jelsma, 1997), we have analyzed this part of the case history as deriving from an early alliance with one selected lead user instead of a broader range of users, with whom the tests were conducted. After successful conclusion of these tests, the number of try-outs with other users was expanded, and it turned out that in their set-up the enzyme degraded. The dilemma for management is that early alliances are necessary, but clearly also a risk, if there are specificities (which one does not know beforehand). Although we do not have quotes from the interviews to this extent, we suggest that the Project Team was using a story line in which their early user had become typified as 'the' user, sufficient to represent all relevant users. In our second round of analysis, we shall indicate such a typification by writing THE USER, in capital letters to

emphasize its generality. Here, the point is that typification entailed that inquiries about specificities were deemed unnecessary and other users were moved to the background. This is a general feature of typification, and we will come back to it in the next section.

After the near catastrophe of the product degrading under regular conditions of use, the Project Team tried to work with more than one option - as it were creating alternative scenarios which could be taken up in case the main road map threatened to destroy the prospects of the project. Besides this particular way of reducing, or at least handling, uncertainty and contingency, other ways were visible from the beginning. Schemes and planning were important to reduce complexity on paper, hopefully becoming self-fulfilling prophecies. Experts of various kinds were consulted not just to solve a problem, but also to be aware of possible problems.

Another example of narrative reduction of complexity, which oriented (and thus constrained) action for some time, is the alliance forged with a carefully selected foreign firm, well located in the markets of animal feed additives and expected to be knowledgeable about formulation technologies and about registration procedures. While the Project Team and the Board of Directors had put high hopes on this alliance, the specific expertise of the alliance partner appeared to be of little help in this case. The Project Team had created a character in their story of the product development process, the ally, to play an important supporting role. In other words, they had made a typification, THE ALLY. It took quite some time before they could believe that this partner did not avail of superior know-how for these specific enzyme formulation problems.

When looking back on this episode, Bentrom and Orlans still find it necessary to argue that there had been good reasons for the alliance, and/or that they could not be blamed for not checking more carefully. Clearly, there is a conflict between the dynamics of evolving accounts at the time (which can be understood narratively), and the need to present a consistent retrospective account now (which is narratively necessary, because the project turned out to be successful).

Bentrom and Orlans explicitly used stories to manage the project team: for team building, to make sense of unexpected events, or to motivate team members. Bentrom's stories were like the external scenarios constructed at an earlier stage to convince others, and in particular the Board of Directors, that they should support a project to develop Gammese. The difference is that he now uses events, views and stories from the outside to persuade his own team members of the importance of the Gammese project.

The comparison shows that narrative plays a role in the transition from project to environment, as well as the other way around. The thrust

developing in and through the project derives from the linkages across levels and their precarious stabilization. Telling the project story to third parties, elsewhere in the company, possible external allies, and audiences to be appeased, leads to reciprocal expectations and commitments, whether it is done for substantial or tactical reasons. An author writing a fictional text is constrained by the features of his characters and plot, in relation to the author-reader collusion he wants to maintain. In the 'genre' of product creation processes, there is no single author, and no master text being written. But there is a similar reduction of possibilities (and thus of complexity and uncertainty) which enables the various actors to be productive, while at the same time constraining them in certain directions. Phrased in this way it is clear that this is a matter of narrative infrastructure.

Telling Yourself Forward, and Telling the Product Creation Process Forward

A certain thrust developed over time in the product creation process of Gammese-to-be. The narrative infrastructure that emerged shaped action and interaction, and helped to create overall patterns in the mosaic of stories so that finally there emerged the Gemmase story. It must then be possible to rewrite the case history in terms of characters and (evolving) plots, and so bring out its narrative character (in the broad sense). This will support, by demonstration, our general contention about the narrative character of the reduction of complexity and uncertainty and the building up of linearity and a thrust.

Characters in the Gemmase story, typified as 'hero' or 'ally,' and phrases like 'telling yourself forward,' are used as semiotic categories (in the broad sense, which we denoted as social semiotic). That is, they are not descriptions (in the modernist vein), but indications of plot and character as these emerge - but with strong implications for subsequent actions and interactions.

The stories told by Orlans and Bentrom to the team position them as a Gideon's band. They are the heroes who have to make the promise of Gammese come true. Institutional-memory stories support this effect by reducing uncertainties: we have had this problem before, but if we put in enough effort we can solve it. Stories about the importance of Gammese in the wider world have an ambiguous character: the project team leader uses them to motivate his team, but in doing so also has to set up Gammese as the hero in a story in which environmental problems are solved. A similar ambiguity is visible in the stories for the Board of Directors, where the Project Team works for its survival by positioning Gammese as the hero

which solves environmental problems as well as public acceptability problems. In the interaction with interest groups, the only hero is Gammese.

This may be a general pattern, which implies that management by story telling should be located in a broader context in which resources and allies are mobilized and barriers are overcome by versions of the story that is used inside. Management by story telling, influencing sense making of team members, is then not independent of the links in those stories with the wider world.

Adding the links between the work unit and other levels of the organization, and with the wider world, the setting is recognized as part of the narrative. Thus, one can understand how the structure of the overall narrative reflects the telling of oneself (one's collective self) forward. This is particularly visible in external interactions: the internal interactions and narratives are black-boxed, and the black box is labeled with the intended product of the work ('we are the Gemmase Project') - while the product itself ('Gemmase') then becomes the main character in the external stories.

How the Project Team Became Part of Its Own Story

The start-up story sketched a future world in which the product to be developed turns out to be successful and helps the firm as well as customers/users, and it identifies a core group, the Project Team to be, as the character that must be supported. Roles are specified for various characters, who can become co-authors if they are willing to go along - which they may refuse. Such role specification and enrolling has been analysed before, for instance the electric-vehicle world projected by Electricité de France in the 1970s (Callon, 1986a). In this case, Renault was enrolled at first, but then stepped out of this world, which hastened its breakdown.

At first, the Board of Directors is a key character, an obligatory passage point because of its authority and power over resources. When the Board goes along, a protected niche is created for product development. The scenario for a future world has to be realized by the Project Team and its allies, and so a purpose is created at the same time. The purpose contains an element of general motivation, but also a story, an evolving project plan that functions as a stylized narrative guiding the various characters. Realizing the project plan creates agency: the Project Team will make a difference, at the same time as it will put Gammese on the map.

Orlans and Bentrom often positioned themselves as independent agents, enrolling others, mobilizing resources to their own purpose, and framing and telling their stories to that effect. But telling a story in which you are a

character yourself creates constraints as well: You become a character with a specified role in the subsequent stories of the listener/reader and you cannot permit yourself too much deviation from the expectations connected with from this role.

The Project Team positions itself as rising to the challenges of the innovation journey, and so cannot shift tack with respect to its plans and promises without losing its identity. This effect is reinforced by the need to tell, and continue to tell, stories to the outside. If these stories are accepted, the Project Team is now also a character in the stories of others, and cannot free itself from the obligations these bring with them without losing credibility or otherwise dropping out of the fabric of intersecting narratives it had been contributing to for its own purpose. The burden this creates may eventually become too high and the Project Team might give up - as happened in the TENAX case mentioned earlier, where the Project Team suddenly reversed on its promising stories, to the surprise of its Board of Directors and some of its outside allies (Van Lente, 1993).

While the Project Team is the central character and has to confront the challenges, it is not alone in its heroic task. In narrative terms: there are allies and subsidiary heroes. Its relation with the Board of Directors is ambivalent: as a benevolent sponsor the Board is an ally, but it is also a threat since it can withhold authorization and resources. The Project Team reports to the Board, and makes sure it shows how it follows the project plan, or else has good reasons to deviate from it.

Relevant actors become characters in the overall story. The lead user at whose plant tests would be conducted on formulation, and in particular the behaviour of Gammese during pelletization, becomes THE USER. This is a typification which blackboxes and thus obliterates the variety of circumstances of application. Similarly, the German firm with hopefully complementary expertise becomes THE ALLY. In all cases, the Project Team assumed authorial discretion to locate the character (including the human and non-human actors it contained) as it saw fit - and was unpleasantly surprised when the character went its own way.

Non-human actors participate in the narrative in the same way. Gemmase-to-be is part of the cast from the very beginning. Genes of *Aspergillus* and the possibility of modifying them in particular ways turn out to play a role in acceptability of the process. Properties of the enzyme are translated into functionalities, cost-effective production in the lab and then upscaling - these are part of the standard story of a product development process, and the non-human actors are assumed to accommodate to the roles assigned to them. Again, rather than allies and subsidiary heroes, they may turn out to be untrustworthy, confusing or even act as opponents in a battle that the Project Team might not win.

The Product Triumphant

Specific to narratives of product creation processes is the presence of what we call, for want of a better term, dual heroes. In the start-up story, a promising scenario about a world with Gammese to-be-developed allowed resource mobilization and the creation of a protected space for a project team with a purpose. The Project Team is the hero, but to continue its quest, it has to tell stories about their eventual product: how it will become profitable, how it will help the company present biotechnology as really useful for society, how it will support agricultural authorities in overcoming waste problems, etc., etc. Such stories are necessary, but derive their power from the setting and the interactions played out in it. A narrative infrastructure emerges in which another hero is born: Gammese itself, which will stand triumphant in the end. The Project Team, because of its own success, will become invisible.

We suggest that this shift from the innovator to the innovation as hero will occur in every product creation process, and necessarily so because the attempt to move forward on the innovation journey, involves inevitably the emergence of a narrative infrastructure which has the product to-be-developed as the main character. In isolated stories, told on particular occasions, one or the other hero will get the limelight. When the innovation project is seen as an evolving narrative, the complexities of the plot reflect the criss-crossing linkages between actors trying to position others, and being positioned by them. Because their shared reference point is the product to-be-developed, this will take on a narrative role of its own. When the innovation is successful, it will eclipse the agent which prepared its way.

The converse happens as well, as in the case of Aramis, a failed project for new subway vehicles and guidance systems, described by Latour (1992). The Aramis story is the tragic version of the 'product triumphant' plot. The innovation fails, and Aramis disappears as a character. In Latour's story, he fleetingly appears to Latour's alter ego, asking why he was not allowed to come to life, and accusing the alter ego of faintheartedness.

Reflections

We have demonstrated that product creation processes can usefully be studied with a narrative approach. We have shown how complexity and uncertainty is reduced, and presented as reduced, in accounts building on each other. We let some of the actors speak, while locating them in processes in which an overall thrust was built up at the price of constraints,

in which problems were encountered partly because of the way the Gammese-story had been shaping up, and where a new hero was born precariously.

We also attempted to reduce the complexities of plots and characters emerging in this way, to make them intelligible and applicable to other product creation processes. For example, the identification of a story about how it all began, is itself an origin story, a projection - and thus a meta-story - on the complex and contingent streams of events and interactions at the time, which attributes originating force to some actions and interactions by selectively highlighting them. Such a meta-story feeds into another narrative infrastructure, which enables and constrains the discussion of the nature of product creation processes.

Our rewriting the product development process of Gammese enhances understanding, but also unsettles actors. When Orlans and Bentrom read our analysis, they recognized the points we made as real and valuable - but also felt slightly uncomfortable being positioned as characters in a story, and seeing their own modernist terminology between quotes. Managers typically write (i.e. produce texts and stories) in a modernist vein, assuming their own agency, and assuming readers who will follow them in their exposition, and who can be routed and re-routed. If they recognize the possibility of another genre, that of developing an interactive narration in which they themselves are personages, they will be more flexible, and perhaps more reflexive: they can see themselves as characters in a multi-authored story, rather than prime movers who mould the world and the word to their will. We would argue that actors will be more effective that way, or at least can then avoid being buried under the weight of circumstances and reactions that they had shovelled out of sight. We would like to argue that inchoate organizational realities can be addressed better through the second genre - realizing that this argument about how to be successful is itself phrased in a modernist vein. It is because of this conundrum, how to make a difference when one realizes that making a difference does not really depend on one's own action, that we discussed the relationship of text and action, of agency and narrative (see also Mike Michael's discussion on representation, performativity and materialisation in Chapter Two of this volume).

At a deeper level, agency of the actors is shown to be constructed through narrative. While agency as an independent source is an illusion, stories which introduce heroes and villains and thus create agency, and guide it along, have effect. In that sense, agency is a productive illusion. Some reflexivity is necessary to avoid becoming a prisoner of the illusion. The overall thrust and the narrative infrastructure is the outcome of such interacting narratives.

Contested Characters

A general reflexive lesson is the recognition of the duality of creating characters - THE USER, THE ALLY, THE PRODUCT-TO-BE, THE ADVERSARY - which are not only typifications but also actors/authors in their own right, which go their own way. While this can be read as simply saying that one cannot force others to do as one wants, the point is that actors often behave as if this were the case. The narrative shaping has a strong hold. It is through recognizing these mechanism, and in concrete situations, that the point is brought home. Meta-stories like the one we developed in this chapter contribute to this recognition, and stabilize it.

Thus, the recognition of the role of narratives in interaction is important, because it offers a handle on heterogeneity and ambiguity in the life of organizations in rapidly changing environments. Directly, in specific stories and interactions, because 'narrative permits ambiguity and enjoys paradoxes' (Czarniawska-Joerges, 1995, p.15). And over time captivity in an emerging path-dependence decreases when streamlined reconstructions of innovation journeys are recognized as effects of narrative infrastructure.

This conclusion, however persuasive and important, hinges on the existence of a boundary between the inside (where heterogeneity can be reduced with routines) and the outside, the external environment, full of strangers with their own visions. Thus, we need a second conclusion since narratives are not limited to one's own organisation but, instead, are implicated in the narratives of 'others'. On occasions, the narratives of such others will contest and destabilise an otherwise heroic production narrative.

In other words, the 'product triumphant' may be victorious on its own terms, but not necessarily in the wider world. This is a cautionary message to the enlightened modernist project managers. But the message works also in the other direction: the contested futures pressed by actors in public spaces produce an interesting spectacle, but is this more than a show for public audiences? In order to be effective, there must be links with product creation processes and with processes of embedding in society. Actors must realize that they are characters in the stories of future worlds put up by other actors/authors.

The notion of 'contested' futures then shifts from a battle of interests, with the scenarios, promises and risks as weapons in the struggle, to a recognition of narrative and narrative infrastructure as the environment (context, repertoire) through which actors define their preferred actions, and in which they position themselves and others. If this is the basic pattern, biotechnology firms (the small as well as the large variety), venture capitalists, retailers, consumer and environmental groups, all collude in creating a multi-actor - and multi-authored - story. Instead of becoming a

victim of the tensions inherent in attributing praise or blame (as is common in controversies), one might go for re-description and conversation (Rorty, 1989) - provided one understands and accepts heterogeneity and the limited scope of a narrative in the context of wider narratives.

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