Maximising outputs from early stage research collaborations

Dynamic, long-term benefits and pitfalls of life science partnerships

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Abstract—**With over 30 cumulative years of international experience in establishing, fund raising and managing collaborations involving industrial partners, between companies and with academia, this DWC white paper provides insights on how to maximize outputs for all stakeholders from large scale international and depending on the size of the country, domestic, partnerships. We leverage our experiences in what has worked, and more importantly what did not work, why and what should have been done to correct it. Fundamentally, serious reflection on design, focus and expected outcomes needs to be performed prior to starting any such project, but if done so correctly can generate significant benefits.**

Keywords- research alliances; optimized management; degenerative diseases; regenerative medicine; healthcare industrial sector; cost-effective therapies; business; innovation

I. INTRODUCTION

Aimed at those entities who are involved in the planning and implementation of pre-competitive or early stage collaborations within large scale networks which aim towards providing a long term profitable outcome, this paper will provide insight on understanding the dynamic, the benefits and the pitfalls of such a plan and how to extract the most value from such a project. We illustrate our experiences in optimizing management structures specifically for the degenerative diseases/regenerative medicine sector, which can create enhanced value addition for all, and can be adapted for use in other sectors.

II. NOT REINVENTING THE WHEEL

Collaborations, joint ventures, and partnerships between and amongst industrial partners, or between industrial and academic partners is not a new phenomenon; lately it has received increasing focus as the patent cliff dominates headlines while entities attempt to identify where the next cost effective and profitable product is going to come from. Solutions are not forthcoming and indeed seem increasingly elusive, which has been compounded by the perfect storm of financial recession and a socio economic demographic based on an increasing ageing population with tissue degenerative diseases who spend nearly as much time in retirement as they did working.

Collaborations have therefore been a core strategy of life science research since commercialization of research was first identified to be lucrative. Public funding systems such as the PPP in Australia, the European FP5, 6, 7 and IMI schemes, or private schemes such as large company sponsorship of research institutes, more adventurous approaches such as FATE Therapeutics or the Pfizer Global Centers for Therapeutic Innovation are now receiving increasing amounts of media coverage and represent larger scale and more complex approaches to address a real market need. It is however still unclear if or how such complex approaches can add value or resolve the issues of the healthcare industrial sector.

Probably the biggest area of confusion we can identify at present is related to the trending phrase ‘pre-competitive space’; all efforts to identify precisely what it is and what benefits working in it have, has not been awfully clear or evident; in brief, inside DWC we do not know what it is.

The reason is because **all** of **our** clients, who cover the full spectrum of research, from very fundamental not-remotely-linked-to-humans research through to clinicians and product developers, are all competing in their respective space; basically none of them operate in a non-competitive environment; in each case the main focuses of competition are on being the best or first, with a very linear connection between this and having access to funding; collaborations are used to increase the possibilities linked to these two success parameters with the outcome being a publication, innovation or product.

Understanding the total competitive environment represents a fundamental key to maximizing value from large-scale collaborations, because to integrate in any single collaborator without understanding their underlying motivations and motivators will prevent the project from achieving its defined goals; unclear agendas create conflict and confusions multiply as perceived points of competition become nodes of argument.

Short of being corrected by our peers with a better definition, we therefore consider that by ‘pre-competitive’ it infers where ‘no competition has been defined’ which arguably means areas where ‘no value has been defined’, the argument being that if a value had been defined, by default there would be competition (at least on planet earth).

In such a scenario we are obliged to therefore consider the risk-adjusted net present value (rNPV) and discounted cash flow (DCF) calculation approach, which implies that by pre-competitive we mean early stage pre-clinical moving

backwards to early stage conceptual: risks are high, identifying winners impossible, valuations incalculable; pre-competitive therefore becomes pre-valuation. Unfortunately, based on recent customer behavior, we are also not convinced that these models provide helpful definitions either, and are quite possibly no longer accurate, mainly because there are strong indications that the little 'r' in rNPV seems to have shifted somewhat to the right.

III. Product Validation ≠ Sales

As clinical development and validation successfully proceeds, risks decrease and a value can be assigned to the product because the market is more evident, and as the drug passes all regulatory requirements it is finally approved for launch… great, you have your product!!!...Well not quite, in reality you have a product if someone or something is willing to buy it.

While approvals of drugs maybe holding steady or indeed increasing according to some reports, and this does bode well for confidence in the R&D and approval process, there does seem to be a worrying increase in the reimbursement agencies refusing to buy the therapies e.g. BMS and Orencia, GSK and Benlysta and more recently Genomic Health Inc and Oncotype DX, because they were considered not cost effective with regard to Quality-Adjusted Life Year (QALY); interestingly level of innovation was not a criteria used for reimbursement. While in two instances the decision was reversed after two years, in the other it was not; irrespective this has a large impact on the return on investment (ROI) and bottom line of any business and the industry overall. Shareholder confidence can be eroded, followed by the investment market, then specialist investors. In addition, the public agencies who support research and innovation, which increasingly want their academic labs to perform translational research, now see academic entities as supposed drug developers, but see that there is no revenue generation in trying to translate innovations to the clinic sequentially cut funding, so the academic labs become undersupported as well. If published figures are to be believed the industry average ROI on R&D is between a whopping minus 2 to minus 7%, or alternatively, lets go outside and burn our money. The perfect storm is starting to look like a perfect hurricane.

Even though at present many companies are presently doing well on their existing pipeline, the future does not seem so bright, indeed it seems that single class blockbusters are quite possibly now market anomalies. Common sense and addressing how most agencies are presently operating would indicate that if a company is making that much money from one drug, the reimbursement agencies or Health Maintenance Organizations (HMOs) are logically going to demand buying it cheaper; the profit margins will be smaller but the argument will be that this is a profit and therefore be thankful. If you do not believe the feasibility of this scenario occurring take a closer look at the construction and civil engineering market which is almost totally dependent on public service contracts and seems to work on short term loss to balance long term margin; it's a vicious cycle resulting in fighting over the bottom line and ultimately the risk of lower quality products. Probably not something we want to see in the life science sector.

IV. A Herd of Elephants Doing the Can-can

There no longer seems to be an elephant in the room; todays market is much more explicit, and applies globally, the customer and the stakeholders (patients, agencies, healthcare providers, healthcare support, governments, insurance companies) all want medical products that are:

- Cost-effective (resolve direct and indirect costs);
- Reimbursable (it is affordable for customers; governments and HMOs);
- Reproducible (so it is worth reimbursing);
- Broadly applicable (a platform to be tailored and expanded);
- Exportable (it works for everyone, everywhere);
- Generating a return on investment greater than 3% (so it is worth it)
- Address the present demographic and provide more than palliative treatment, preferably restore or maintain function

It's a complex list to satisfy specially in light of the reported costs and associated time for therapy development, and one market response has been **repositioning** and repurposing, with large companies making their abandoned libraries available for testing by academics in other diseases in a public setting. This may result in high revenue generators, albeit fragmented between a larger numbers of markets. Matched with in-house repositioning of marketed drugs, the model is exciting and creates a real opportunity, especially for large-scale collaborations between academia and industry.

There is a unique opportunity to pull together opposing cultures in the life science sector, and generate real value, which leverages the issues that are facing the industry and turn these into market drivers and enablers. In the context of the ageing demographic, the fact that academic research focuses generally on specific issues related to rare or less common diseases (as those with high commercial value are already extensively addressed), there is real strength and opportunity. In rarer degenerative diseases, to generate any significant research impact, not only do the key molecular and cellular triggers for the disease have to be detailed, but also their impact on tissue function and the potential underlying regenerative mechanisms should be defined. Amongst many diseases, and across tissues, some of the major obstacles to restoring function are shared, therefore insights can generate therapies for rare diseases with an impact on more common disorders.

Critically, the outcome should be a limitation of the degenerative process, matched with a restoration of tissue function, as opposed to a palliative treatment. If extended to the global issue of keeping the ageing population operational and contributing to society, will represent the real impact of regenerative medicine research. Whether this is achieved by using chemical entities to stimulate endogenous cells, transferring biological growth factors or attempting to

reconstruct the tissue, the outcome remains highly beneficial and lucrative, and low costs should be achievable.

At present, and our colleagues who need funding may initially disagree, maybe one of the benefits of the combined recession and demographic driver is the generation of a common frugal innovation culture, which needs to generate cost effective therapies for a global problem, in which the majority of the markets are not massively wealthy. Originally emerging from the BRIC (Brazil, Russia, India and China) economies and social entrepreneurship, the concept, to quote the INSEAD Business School is *"the ability to generate considerably more business and social value while significantly reducing the use of scarce resources"*. In the context of large-scale collaborations, a similar perspective can be taken; the aim is to maximize total output from all resources in a focused and cost effective manner. Arguably this is not synonymous with academia, but this then becomes part of the structuring process of the partnership.

It is obvious that therapies need to be created and validated cheaper and faster, to generate a lower cost product which still works and therefore agencies are ready to buy; the product should also be designed for known disease targets, or at least well described diseases with the capacity to be easily adapted for new ones; an area where those working in degenerative diseases and regenerative medicine have an advantage. This can be achieved through large scale collaboration, in which budget expenditure can be restricted while benefits maximized: to coin terminology from physics, what maybe a core collapse at present, if structured correctly could become a supernova.

V. Due Diligence

We cannot stress this point enough and in our opinion is the key to success: due diligence needs to be performed for all components of the project: the science, financial management, contractual management and then matched with funding and focus expectations (see below). The due diligence should be performed by the management team, which is either from the funding body, or is a separate management team that understands the funding bodies required qualities and standards. In the case of the latter, a representative of the funding body should participate in the review of the due diligence outcome.

Having great science is not enough; we have witnessed a sufficiently large enough number of examples of top quality scientists being stifled and drowned by their own administration. This is fundamentally heartbreaking because the scientists who work in these types of entities encountered difficulties to be part of collaborations and end up not working properly.

Due diligence should initially be performed on the scientist, we anticipate this is the natural starting point, with a review of their work and capacity to collaborate; by default the scientist should have a clear track record and/or be an opinion leader, but beware, many great scientists are not natural collaborators and this should be seriously considered and measured before any expenditure of funds starts. Due diligence should also be performed on how the lead scientist manages her/his own team and the relationship between the staff.

A project critical due diligence needs to be performed on the administrative support; this applies to both companies and academia alike, as there is no legal obligation for a company to retain the services of a quality accountant. Before starting the diligence procedures, make sure you understand employment law constraints in each geography and how this maps with being innovative, identify what are the accounting and book keeping procedures and obligations; are the scientists kept aware of their expenditure or are funds left to be overspent and then an 'oops' e-mail is sent out. Are the scientists aware of the procedures, is there a good relationship between the scientists and the administration, do the administrations keep things simple or very complex. All of this will give an insight into how the back room operations of the collaboration will function when the project starts. Bad financial and contractual management now, means delays, and failure, tomorrow.

Resource and project due diligence are always necessary when there is money on the table, there is a natural human reaction to oversell, and we would encourage a business angel (as opposed to a venture capital) perspective in the due diligence. In other words, resources (personal and physical) have to be there, available, high quality with a short-term value extraction from them. Basically is everything there that is necessary to add the value within the next 3 years; in the majority of cases the answer will be no, but then through the integration of complementary partners, the gaps are filled; it also empowers a tighter financial control and awareness of all partners. Save yourself the long-term headache; get this done first otherwise the experience will be much more painful.

VI. Structuring and Focusing the Partnership

There is no need to regurgitate the differences and similarities in culture between academia, small industry and large industry; they are well known, and if there is the motivation to advance together then within the constraints of a contract, which defines liabilities and confidentiality to which all parties are bound, it should then be a totally open communication. Each party should arrive with their list of what they have and what they need, and the list should encompass everything that is going on and where failures have occurred.

In the context of bringing in industry who likely have a plethora of failed attempts, therapies looking for a target and the know how of moving something towards the clinic and academia who possess unique insights on disease and disease mechanisms which are completely non profitable, but can provide information that can be moved laterally into profit (less cryptically research on rare diseases, provides insights on easier targets in regenerative medicine, which can then be translated to a tissue class).

A clear communication of expectation and focus needs to be laid down from the start, including what is the required Quality Assessment/Quality Control standard; while working within a conceptual and fundamental arena, there also has to be a clear eye on the horizon of what the benefits should be and how the partnership is going to get there. Ideally, the project should be structured as a tube, in which the tube itself is the common vision, such as "stimulating angiogenesis in soft tissue", or "blocking fibrosis and inflammation in damaged tissue".

Within that tube are a multitude of portfolio projects oriented around small groups, typically not involving more than 3 or 4 persons, each person from a different member of the partnership. The project should have clearly defined schedules and milestones, which are designed and then approved by the teams themselves. The portfolio projects should be between 2 and 3 years in length, should also be costed precisely from a consumables and man power engagement perspective. While we may all want to have salaries for our personnel, full time for the year with no accountability, this no longer applies. Personnel involvement in "collaborative" projects should be calculated at between 10% and 20% of a person's time per portfolio project; ideally from a funding perspective one full time person in academia in such a system should be involved in between 3 and 6 portfolio projects, occupying a maximum of 60% of their time, with the remaining 40% made available for that person to perform a fundamental project, on the provision that it is complementary and answering a key question linked to the common vision.

By combining due diligence and project design within the common vision, the list of entities that should be involved in the project becomes naturally very short which is beneficial to the project plan financing, its internal management and its impact. We argue that a maximum of 10 quality partners should be involved in any given large scale collaboration, meaning around 40 personnel, and in such a structure and format, this means that there should initially be between 50 and 70 simultaneous portfolio projects, depending on complexity, which naturally narrows down to between 20 and 30 based on milestones, matched with between 20 and 40 fundamental projects.

VII. Money and Reporting

Irrespective of where the funding comes from, the management of money should be approached from two perspectives: how the teams should be allowed to engage funds, and the final cost of the product; each should be managed without compromise.

In any given collaboration, as stated above, we think there should be no more than 10 teams, and ideally each team should receive 300 000 sterling (or equivalent) per year for 5 years. Overhead rates should be set at 20% on top of direct costs; if the entity paying for the research wants exclusive Intellectual Property (IP) rights, then they should be paying for all IP costs on top of the R&D plan. If IP rights stay with the entities then another 5% should be kept to cover the costs of personnel and initial IP protection.

This means that at a minimum each team has £ 240 000 per year, from which one can anticipate that around 4 full time personnel, some travel and consumables can be paid for. Finally it should be made clear that tenured personnel can bill no more than 10% of their time to the project; we do understand full economic cost, but we also have witnessed too many promising projects crippled as senior personnel who are supposed to be paid by the entity from other sources, are then charged full time to the project, but do not work on it.

There is a tendency to ask for more, but if these are established scientists and opinion leaders, obtaining supplemental funding for congresses, travel and consumables should not really be an issue; if it is then this should be addressed during due diligence.

With respect to the final cost of the product, we advocate an approach that if it is not affordable in a BRIC country, within the realms of cost:benefit and QALY then it shouldn't be developed. We feel comfortable stating this as the costs of the technologies linked to degenerative diseases and regenerative medicine, including product production are decreasing, while if the outcome is a repurposed drug then the costs should be considerably lower anyway.

The team members of the collaboration should clearly understand this perspective and factor it into their project design and ongoing steps for translation. They should also be aware that they are expected to report on activity and on expenditure: both report formats should be kept very simple and should be integrated in with the management structure described below. We prefer reports based on milestones, as they are actually read and assessed, it also motivates each portfolio team to focus on the objective they are aiming for.

No delays in any of the reporting (financial or milestone) should be permitted, and it should be communicated that any delay will result in an immediate suspension of funding. Financial reporting should be as simple as the regulations for the expenditure, with a clear link to funds engaged but nothing more complex than this.

Many entities will complain about the low overhead rate, however if an entity is in such dire straits that it needs to charge excessive overhead, then the question on whether the infrastructure is well suited to perform the collaboration, why anyone should pay for this and how this fits into the present economic environment needs to be addressed.

VIII. Contracts

We want to briefly refer to contracts in the context of geographic differences and IP.

Regarding the latter, unless it is a charity that is paying for it, for any newly generated IP, the entity that is paying for it should have exclusivity, a first rights of refusal or reduced rights if any IP is commercialized, or a combination of the three. Charities increasingly ask for a percent of IP rights as part of their funding support to achieve sustainability. We seriously doubt that a public entity would support such an endeavor given the values necessary to be engaged to have an impact and the focus of the approach itself, however if one does, then an independent technology transfer specialist should be given the task of monitoring exploitation and liaising with the technology transfer sections of each entity to ensure that this is performed correctly. By correct we refer to the, now old, APAX ventures report in which it was reported that most IP generated in academia has no value.

A significant issue that needs to be dealt with upfront, specifically in collaborations between countries, is a common contract. In collaborations between North American and European entities there is a combination of state and national laws, with limited federal protection. It can be messy, and despite being a little frustrating, based on the non-Federal

structure of Europe, in which sovereign law predominates, Europe is a little more advanced in addressing this specific component of an international collaboration. As far as we can determine, also based on our experiences in managing collaborations between the two continents, the equivalent of a 'consortium agreement' is a necessity, and needs to be discussed and agreed upon before the project starts. It permits all entities to address liabilities (there should be none or as few as possible between parties), responsibilities, access rights, confidentiality issues, financial plan and transfers and ownership in a common document. The Lambert Consortium Agreements are good models to work around and edit for need. It should be supplemented with annexes in which any exchange of material is accompanied with a bilateral Material Transfer Agreement in which the jurisdiction for dispute is agreed upon between the two entities exchanging material. A common law applicable between continents is impossible to agree upon between more than 2 entities, especially if state law, national law and international law have to be balanced. For purposes of need, we would recommend selecting a historically neutral country with experience in life science or if the funding entity wants to ensure total control, within their own jurisdiction.

To put this into context, take a scenario where a University from Florida takes up issue with a Research Institute from Sweden and they have agreed to be subject to law in Florida. At its most basic the University in Florida has to spend a lot of money to obtain a liability from Sweden, which if Sweden refuses to pay because it does not feel that the judgment was correct will then need to be corrected in a Swedish court of law. It ends up costing an awful lot of money to both entities for not very much which in itself should be a large enough deterrent in the context of early stage collaborations to reconsider litigation and try a different route.

IX. Implementing the Project

Once the above points have been addressed and agreed upon, one can argue that the collaboration is ready to start, and effectively addressing the following cultural and operational aspects before the start of the project can increase the possibility for project success.

A. Having dedicated skilled management personnel

Having experienced and qualified management personnel are critical and should be included on top of the costs related to the research; for the project structure indicated above, 1-2 managers are needed with a part time assistant. Ideal managerial candidates should have a PhD in a related research field, international experience (preferably on another continent), have been exposed to the business environment, be entrepreneurial, be very good at fund raising and grant writing (writing, not just letting the scientists know that the grant exists) and very happy functioning outside of their comfort zone. There is an increasing presence of strategic management teams, but appears to only receive extensive investment in the top centers, however we feel, all centers to some extent should mimic the others and invest correctly in a dedicated, experienced and skilled partnership management office, which collaborates with but is ideally separate from the technology transfer office; more efficient still the management office should be located with the scientists.

B. Embrace and champion the portfolio approach

Portfolio management is typically considered an 'industrial model' however early stage research can also be managed with a similar approach and creative sparks fly and phenomenal insights generated when the academic and industrial sectors are correctly combined under the same management scheme integrating diverse disciplines. On at least 10 different occasions having access to brand new data, while understanding what is happening in all other portfolio projects permitted us to network teams, and solve problems; applied approaches could be used to solve fundamental issues and vice versa.

C. Develop an appropriate communication strategy within the partnership

The only way to maintain productive collaborations between international teams is to use all communication tools available, so that members can update their collaborative partners on work progress, exchange new data, or discuss technical issues on time, in between physical meetings. Firstly, and by experience with the alliances we are involved in, web-conferencing is a very efficient communication tools as it does permit on screen presentation of data in a cost-effective manner – the scientists not leaving their desk. Secondly, the development of a secured intranet or web-based milestone management system is also crucial for portfolio management.

D. Monitor the knowledge silo's

Each research team (academia and industry alike) has immediate access to enormous amounts of information, which is traditionally untapped, unmapped and unknown, including failed attempts. Up to 90% of what sits inside any research group's refrigerator is undeveloped because of resource prioritization and therefore their collective brain remains unexplored and non-communicated. In a virtual environment by complementing the portfolio project meeting with virtual 'total science' presentations, the team members are encouraged to present in a department like meeting all their ongoing research initiatives which typically integrates in research from their local team members who may not be members of the portfolio team. If matched with virtual training courses, in which the same scientists have to structure the information being presented in a didactic way, a collective knowledge base is generated which serves as the foundation for identifying non developed ideas which with incremental investments can generate significant returns.

X. Operations

A. Empower and pro-actively develop the young scientists

The young scientists, from both the academic and industrial sectors are the motors for success. The worse possible structure for international portfolio management is the T shaped management approach. If the partners have agreed to collaborate, the contractual constraints have been agreed upon, and the project plan defined let the young scientists get on with it. They know what works and what does not and once trust is established they will move the projects forward, while simultaneously developing new ideas. A 'can-do' culture matched with advanced training so that all project members understand all the components of the project generates

advances that are both fascinating and bewildering when matched with correct resource management.

B. *Generate an innovation and communication culture*

Establish a culture, which leverages the virtual, and the physical environment. Physical meetings of the portfolio team members every 6 months, matched with formal web conferencing for portfolio project monitoring and ad hoc web conferencing for brainstorming resulted in teams that want to work and want to innovate together. Projects advanced faster than anticipated, and decisions to close projects because they were not advancing were made sooner in such an environment. It became easier to identify what could be protected for later commercialization and what data was missing for potentially high impact publications; which by avoiding T shaped management actually makes the Group or Department head's job fun again. They became essentially the purveyors of quality control of the new data and the strategic drivers for new projects.

C. *Keep it simple*

Complicated plans with large portfolio project teams spread across a continent simply do not work. By recognizing that any given portfolio project, if correctly executed, occupies around 10-15% of a skilled scientist's working time by keeping the project plan simple, milestones correctly defined, the project team small and communication channels open advances are almost guaranteed. Ignoring any one of these factors creates confusion, which if left uncorrected can spiral the project downwards and spoil any future potential collaborations.

XI. Managing Value

A. *Focus on value*

Value perceptions for the different actors of a portfolio project are very different. Publications, innovations and inventions have different priorities amongst the sectors and levels, however it is essential to proactively manage the portfolio in such a way that all value generators are considered equal. Most importantly, for the portfolio manager they should be actively monitored, coordinated and communicated; by focusing on all three simultaneously while understanding how each value generator is developed and exploited for monetary return permits a higher level strategic management.

A high impact publication is more easily leveraged into monetary return for sustainable development than an invention, and about 90% of the projects we have monitored we consider publication the greater short to medium term liquidity generator. This by no means suggests that we shy away from invention protection, but considering the costs of legal protection, we only consider this approach a feasible value generator if all the resources necessary to generate the value are to hand: expertise, physical infrastructure, entrepreneurial drive, experienced CEO, defined and known customers and some idea of where the investment is coming from to kick start the commercialization process. In best case scenario's only after we have identified and collated these factors do we consider restructuring the portfolio project plan to fast track development so that high value and quality intellectual property is generated as the seed for commercialization

B. *Total and routine market analysis*

Market analysis typically centers itself in one sector at a time, generating reports and insights, which while useful can be one-dimensional. The major benefit of hiring PhD level managers, is that by default of their training they are highly skilled in screening enormous amounts of information and extracting the pertinent facts, which are mentally recorded and then linked with new facts from other sources (future and historical), which catalyzes strategic development. Portfolio managers, ideally should screen on a monthly basis: all potential funding opportunities (public, private, foundations, charities) that are related to their projects; the activities of patient associations and the initiatives they are implementing in supporting care providers, monitoring promising advances and communicating research (better still, establish a relationship with the associations for the development of mutual trust); scientific publications based on defined key words, which by default informs the managers not only of the competition but also novel targets for the outcomes of the portfolio projects; the industry as a whole from the pipelines of large pharma or the managers not only of the competition but also novel targets for the outcomes of the portfolio projects; the industry as a medical device companies to emerging small companies with limited resources, but unlimited innovation. Finally the economy and political scene as a whole should be monitored, through which the socio economic impact of the portfolio projects can be measured integrating social drivers and regulatory barriers.

XII. Conclusions

It is quite clear that the life science sector is in a large transitional period, which will result in new models for operating and developing therapeutics. Processes and manufacturing approaches for both chemical entities and all types of biologics (here we imply proteins, cells, materials and nucleic acids as drugs) and their screening will eventually have their costs scaled down as part of technological development, which is being driven by a consumer in the midst of a recession. Through collaboration, all stakeholders can have a role to play in this process and benefit from the fruits of the outcomes; repositioned therapeutics, low costs novel therapeutics, one short personalized treatments and the like. *At present, this is where we believe large scale and early stage collaborations specifically between industry and academia can generate the greatest long-term value.*

The benefits of large scale and complex collaborations involving the spectrum of actors in the healthcare field are significant, if organized and managed properly. The key aspect is to structure the early stage collaborations around total partnership quality, without being overly bureaucratic or non sensical. By accessing a smorgasbord of insight and quality resources, and positioning this in the market need and the correctly addressing expectations and benefits a highly collaborative and open system can be created that does much more for less, and from which everyone benefits.

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